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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **4047**

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Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **4051**

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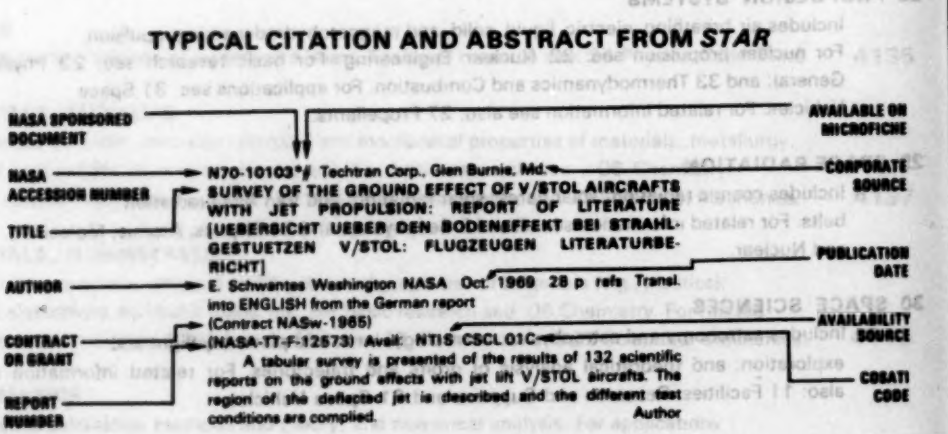
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VOLUME 8 NUMBER 22 / NOVEMBER 23, 1970

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N70-39001*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AERODYNAMICS OF THE MODEL AIRPLANE. PART 1: AIRFOIL MEASUREMENTS
F. W. Schmitz Nov. 1967 201 p refs Transl. into ENGLISH from German report Sponsored in part by Redstone Scientific Information Center
(NASA-TM-X-60976; RSIC-721-Pt-1) Avail: NTIS CSCL 20D

Measurements are discussed that show the behavior of wing sections in the low-turbulence stream (turbulence factor = 1.06) in a Reynolds number range from 20,000 to 170,000 in which the profiles pass through a critical region. This measuring region corresponds approximately to the Reynolds number range of model airplane wings. Author

N70-39012# Aeronautical Research Labs., Melbourne (Australia).
ON THE MECHANISM OF SUPERSONIC INTAKE INSTABILITY, WITH SOME THOUGHTS FOR FURTHER WORK
S. A. Fisher Mar. 1970 15 p refs
(ARL/ME-313) Avail: NTIS

A possible mechanism is described for avoiding Ferri instability in external compression supersonic air intakes. The technique employed prevents a vortex sheet or shear layer from entering the intake within the desired range of mass flow. However, this margin of stable subcritical flow is secured at the expense of preentry drag at the critical condition. Possible approaches to the problem of controlling this instability without the currently encountered drag are discussed. E.M.C.

N70-39091# Advisory Group for Aerospace Research and Development, Paris (France).
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Aug. 1969 282 p refs Held in Brussels and Bolkesjoe, Norway, Jun. 1970
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8. APPLICATION OF THROUGH-FLOW THEORIES TO RADIAL WHEEL DESIGN M. H. Vavra (Naval Postgraduate School) 12 p refs (See N70-39099 22-01)

N70-39092# Cambridge Univ. (England). Dept. of Engineering.
THE THROUGH-FLOW ANALYSIS OF AXIAL FLOW COMPRESSORS
H. Marsh *In* AGARD Advanced Compressors Aug. 1969 17 p refs (See N70-39091 22-01)
Avail: NTIS

Methods for predicting the performance of axial flow compressors are described in detail and it is shown that the methods of streamline curvature and matrix through-flow analysis are based on the same mathematical model for flow on the mean stream surface. The need for an accurate loss model is emphasised and the Mach number limitations of these two methods of analysis are defined. Methods for predicting the development of the wall boundary layers are discussed and shown to be in agreement with experimental results obtained for flows with low angles of swirl. If an accurate estimate of the wall boundary layer can be obtained, then it is possible to predict the flow pattern across the entire annulus. Author

N70-39093# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MASS FLOW LIMITATION IN SUPERSONIC COMPRESSORS
Jean Fabri *In* AGARD Advanced Compressors Aug. 1969 25 p refs (See N70-39091 22-01)
Avail: NTIS

Accurate prediction of supersonic compressor mass flows is the main condition of progress for these machines. As in the case of supersonic aircraft air-inlets, different types of flow patterns may appear. The choked (or unstarted) regime corresponds to high subsonic or low supersonic rotor speeds. The sonic choking of the blade channel throats limits the mass flow. The supersonic (or

started) regime appears for higher supersonic rotor Mach numbers. The periodicity of the shock and expansion wave pattern, that extends upstream of the rotor inlet, imposes the mass flow. The corresponding unique incidence, function of rotor speed, can be calculated. For even higher supersonic rotor speeds, the shock waves are swallowed by the rotor, the inlet velocity in absolute reference frames becomes sonic, and mass flow is independent of rotor speed. The range of validity of these regimes is given; values of limit mass flows are calculated, and experimental results are compared to theoretical evaluations. Author

N70-39094# Advisory Group for Aerospace Research and Development, Paris (France).
TRANSONIC COMPRESSOR CASCADES
H. Griepentrog *In its* Advanced Compressors Aug. 1969 41 p refs (See N70-39091 22-01)
Avail: NTIS

The necessity for investigating bladings with inlet and outlet subsonic flows, but presenting a local supersonic region, used in all of the advanced axial compressors is affirmed. The general features of the compressible flow effects in cascade are discussed, together with the influence of compressibility on the performance of compressor cascade. The notions of critical and choking Mach number are introduced, together with a physical description of the flow in the blade passage, where four distinct regions can be distinguished (subsonic inlet and outlet flow field, supersonic flow field, sonic line region and shock-boundary layer interaction region). The evaluation of the critical and choking Mach number is treated, as well as the effects of compressibility on losses, turning and static pressure rise, and the design of transonic cascades. The four regions of flow detailed above are dealt with independently. A review is made of the existing theories and experimental correlations, and their limit of application for cascade flows is defined. A semi-empirical model, valid for cascade flows, is presented for the shock-boundary layer interaction region. Author

N70-39095# Advisory Group for Aerospace Research and Development, Paris (France).
SECONDARY FLOW LOSSES IN AXIAL COMPRESSORS
H. Griepentrog *In its* Advanced Compressors Aug. 1969 16 p refs (See N70-39091 22-01)
Avail: NTIS

The importance of secondary flows and losses in highly loaded compressor is stressed. The various types of possible secondary flows are described, and the three most usual models representing those flows are presented with their limitations. The sources of the losses induced by the secondary flows are then identified with the relevant cascade parameters, and the classical semi-empirical formula of loss evaluation with actual data on highly loaded compressor blading, it is concluded that they fail in predicting correctly the losses for high camber and/or low aspect ratio bladings. A new model for secondary flow is introduced, based on boundary layer growth on the hub or casing and a horse-shoe vortex model, and a formula is derived which appears to be valid for a larger range of blading configuration. Effects of secondary flow on outlet flow direction, and the methods available to reduce secondary flow losses are also discussed. Author

N70-39096# Naval Postgraduate School, Monterey, Calif.
BASIC ELEMENTS FOR ADVANCED DESIGNS OF RADIAL-FLOW COMPRESSORS
M. H. Vavra *In* AGARD Advanced Compressors Aug. 1969 43 p refs (See N70-39091 22-01)
Avail: NTIS

High speed centrifugal compressors with rotors that have radial blades at the discharge, and where the absolute inlet velocities are in axial direction are considered. With a straight annular inlet duct these inlet velocities will be uniform between the radii R sub 1i and R sub 1o of the impeller eye. For a particular relative flow angle beta sub 1o and the relative velocity W sub 1o at R sub 1o, there is then known the peripheral speed U sub 1o, which, for chosen radius ratios R sub 2/R sub 1o, establishes the peripheral rotor speed U sub 2 at R sub 2. The average relative velocity W sub 2 at the discharge of a rotor with radial blades is not radial, but has an average angle beta sub 2. Author

N70-39097# United Aircraft of Canada, Ltd., Jacques Cartier (Quebec).
SUPERSONIC RADIAL DIFFUSERS
D. P. Kenny *In* AGARD Advanced Compressors Aug. 1969 34 p refs (See N70-39091 22-01)
Avail: NTIS

Various diffuser concepts for centrifugal compressors are discussed with regard to overall performance in the chronological order: vaneless, vaned, passage, multiple cascade and pipe. Then each type is discussed individually with regard to its basic mechanism, design technique, performance evaluation, and possible improvements. Finally, general conclusions are drawn with regard to the capability of the various types and possible ultimate performance. Author

N70-39098# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftstrahlantriebe.
SUPERSONIC CASCADE PERFORMANCE
H. Starken and H. J. Lichtfuss *In* AGARD Advanced Compressors Aug. 1969 65 p refs (See N70-39091 22-01)
Avail: NTIS

An introduction to the fundamentals of supersonic flow through cascades is presented. The effect of back pressure and the starting conditions are described using simplified flow models. The inflow conditions of a supersonic cascade are presented, and approximate methods are described for calculating shock losses and the dependency of total pressure losses from static pressure rise and axial-velocity-density ratio. Author

N70-39099# Naval Postgraduate School, Monterey, Calif.
APPLICATION OF THROUGH-FLOW THEORIES TO RADIAL WHEEL DESIGN
M. H. Vavra *In* AGARD Advanced Compressors Aug. 1969 12 p refs (See N70-39091 22-01)
Avail: NTIS

A review is presented of the basic flow equations for the analysis of flows in rotors, together with a discussion of the effects of simplifying assumptions that are necessary to obtain solutions. Particular flows in radial compressor rotors are treated, and the approach necessary to calculate arbitrary flow patterns for given blade shapes is described. The necessity of using a correct description of the blade surface is demonstrated, and the applicability of the results to the design of compressor rotors is discussed. Author

N70-39147# Scientific Translation Service, Ann Arbor, Mich.
THEORETICAL STUDIES ON THE INFLUENCE OF WALL FRICTION ON THREE-DIMENSIONAL FLOW IN AXIAL TURBOMACHINERY
Juergen Keusenhoff (Ph.D. Thesis) 1966 122 p refs Transl. into ENGLISH from German Rept. Prepared for Oak Ridge Natl. Lab.
(K-Trans-55) Avail: NTIS

The thermodynamic and fluid-mechanical laws determining flow in axial turbomachinery are expanded by the shearing stresses acting between the flow surfaces in such a manner that the mechanism of wall friction becomes physically comprehensible and mathematically determinable. The secondary effects are eliminated by the assumption of flow on coaxial cylinders and profile losses are treated separately, so that only wall friction effects remain. NSA

N70-39164# Sandia Corp., Albuquerque, N.Mex. Experimental Aerodynamics Div.
PROGRAM WTDPLT: A COMPUTER CODE FOR PLOTTING AERODYNAMIC DATA
D. E. Berg Jun. 1970 150 p
(SC-DR-69-690) Avail: NTIS

Program WTDPLT, a computer code designed to machine-plot aerodynamic data acquired in 12 inch trisonic and 18 inch hypersonic wind tunnels, is described. This program is operational on CDC 6600 and UNIVAC 1108 computers and utilizes the Stromberg-Carlson 4020 plotter. The input required by the program is discussed in detail and the various plot formats available are illustrated. Author

N70-39296*# Scientific Translation Service, Santa Barbara, Calif.
GROUND EFFECT VISUALIZATION AT LOW SPEEDS AROUND AIRCRAFT MODELS [VISUALISATION DE L'EFFET DE SOL A BASSE VITESSE AUTOUR D'UNE MAQUETTE D'AVION]
Henri Werle Washington NASA Sep. 1970 27 p refs Transl. into ENGLISH from Rech. Aerospatiale (Chatillon-sous-Bagneux), no. 2, Mar.–Apr. 1970 p 79–93
(Contract NASw-2035)
(NASA-TT-F-13254) Avail: NTIS CSCL 20D

The ground effect on the water flow around models is analyzed using a visualization method in a water tunnel. Ground simulation methods used previously for basic research have been adapted to applied aerodynamics studies. Some examples of models which have been tested are the airbus-type air intake, vertical jet VTOL aircract, and Concorde with or without simulation of the downward movement. Author

N70-39382# Aix-Marseilles Univ. (France).
EXPERIMENTAL STUDY OF THE NEAR WAKE OF A SLENDER CONE AS A FUNCTION OF INCIDENCE AT MACH 7 [ETUDE EXPERIMENTALE DU SILLAGE PROCHE D'UN CONE ELANCE EN INCIDENCE A MACH 7]
Jacques Marcillat (Ph.D Thesis) 10 Jul. 1970 228 p refs In FRENCH
(AO-4707) Avail: NTIS

With relation to reentry body problems, the effects of the incidence on the flow in the near wake of a circular slender cone are studied. The characteristic values of the flow were determined from systematic measures of the arresting pressure, static pressure, and arresting temperature, in the field stretching on one side of the base to a distance of 2.50 times the diameter of the base and on the other side to the shock wave of the top. Probes and flow visualization methods were used. The model was placed at incidences of 0, 5, and 15 degrees in a hypersonic flow of Mach 7 and of Reynolds number 110,000/cm and 25,000/cm. The configuration of the flow around the cone is examined, including wall flow, boundary layer separation and transition, and the exterior flow. The effects of the influence on the zones of recirculation and recompression are discussed. Graphical illustrations and an extensive bibliography are included. Trans. by P.A.B.

N70-39419*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL INVESTIGATION OF BLADE EFFICIENCY FOR TWO-DIMENSIONAL SUPERSONIC TURBINE ROTOR BLADE SECTIONS
Louis J. Goldman Washington Sep. 1970 21 p refs
(NASA-TM-X-2095; E-5532) Avail: NTIS CSCL 20D

An analysis was conducted to determine the blade efficiency for two-dimensional, supersonic rotor blade sections designed to produce vortex flow within the blade passage. Boundary layer characteristics were calculated and used to obtain the conditions downstream of the rotor blades after the flow had mixed to a uniform state. Subsonic and supersonic aftermixing axial Mach number solutions were obtained for this loss model. The effect of the surface Mach number levels on both blade efficiency and boundary layer separation were investigated. In addition, the effects of inlet flow angle and inlet Mach number on blade efficiencies were obtained. Author

N70-39449# Technische Hochschule Hannover (West Germany).
THE EFFECTS OF UNIFORM PROFILE CHANGES ON THE DEGREE OF EFFICIENCY, THE INCLINE, AND THE MASS FLOW IN MULTIPLE STEP AXIAL TURBINES [DER EINFLUSS GLEICHMAESSIGER PROFILAENDERUNGEN AUF DEN WIRKUNGSGRAD, DAS GEFAELLE UND DEN MASSENDURCHSATZ MEHRSTUFIGER AXIALTURBINEN]
Helmut Stobbe (Ph.D. Thesis) 1969 219 p refs In GERMAN
Avail: NTIS

Corrosion related profile changes on turbine blades affect pressure and efficiency curves of turbines markedly. Thinned profiles of the primary stage dominate pressure curve characteristics and the suction capacity of the turbine; thickened profiles of the later stages decrease turbine efficiency but do not affect pressure and suction capacities as much. Pressure drop and mass flow decreases are three times higher when profile thickening in the last two stages is present in comparison with profile thickening on only one later stage. Thus, the fouling of later stages in a turbine affects its capacity much more than corrosion of primary stages. Transl. by G.G.

N70-39707# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
AN IMPLICIT FINITE DIFFERENCE SOLUTION FOR JET AND WAKE PROBLEMS. PART 1: ANALYSIS AND TEST CASES
Ram Sinha, Herbert Fox, and Lawrence Weinberger Wright-Patterson AFB, Ohio ARL Feb. 1970 77 p refs
(Contract F33615-68-C-1184)
(AD-707865; NYU-AA-69-21-Pt-1; ARL-70-0025-Pt-1) Avail: NTIS CSCL 20/4

A solution of the describing equations for chemically non-reacting 2-D symmetric and axisymmetric jet and wake problems was obtained in the boundary layer approximations by an implicit finite difference scheme which permits arbitrary initial and boundary conditions and assumptions for transport properties. The species equation was included in order to analyze the heterogeneous mixing of two dissimilar gases. Initial profiles, measured in detail, are used to march downstream, satisfying the boundary conditions at infinity and at the plane or axis of symmetry at each axial station. The solution is valid in laminar as well as turbulent flow. Flow fields with pressure gradients were taken into account. The scheme, being implicit in form, is free from stability difficulties; it always converges and has a smaller truncation error compared to the explicit schemes and, therefore, permits larger step sizes in the analysis. Several numerical examples were included to demonstrate the application of the method. Author (TAB)

N70-39708# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
AN IMPLICIT FINITE DIFFERENCE SOLUTION FOR JET AND WAKE PROBLEMS. PART 2: PROGRAM MANUAL
Ram Sinha, Herbert Fox, and Lawrence Weinberger Wright-Patterson AFB, Ohio ARL Feb. 1970 54 p
(Contract F33615-68-C-1184)
(AD-707866; NYU-AA-69-22-Pt-2; ARL-70-0024-Pt-2) Avail: NTIS CSCL 20/4

A FORTRAN IV computer program for the solution of chemically nonreacting 2-D symmetric and axisymmetric jet and wake problems, which permits arbitrary initial and boundary conditions and assumptions for transport properties, was developed. Flow fields with pressure gradients and the heterogeneous mixing of two dissimilar gases were considered. An implicit finite difference

method in the modified von Mises plane is used; the results, however, are printed out in the physical coordinates. The program needs about 60,000 memory cells and was written for CDC 6600 and the large versions of IBM 360 digital computers. It is found that a CDC 6600 computer can carry out the calculations for an x-interval of 2500 in about 5 to 7 minutes or less for most cases. Author (TAB)

N70-39747# Ohio State Univ., Columbus. Aeronautical and Astronautical Research Lab.
HYPERSONIC SURFACE PRESSURE AND HEAT TRANSFER ON SLENDER BODIES IN VARIABLE COMPOSITION AND NONEQUILIBRIUM ATMOSPHERES Final Technical Report, 1 Sep. 1968 – 31 Sep. 1969
D. J. Harney and S. L. Petrie Apr. 1970 55 p refs
(Contract F33615-69-C-1077)
(AD-707883; AFFDL-TR-70-31) Avail: NTIS CSCL 16/3

The aerodynamic testing of slender bodies in high energy wind tunnels is complicated by the effects of the nonequilibrium expansion process in the wind tunnel nozzle. The atmosphere that a model sees varies in composition dependent upon the degree of nonequilibrium. This variation affects the inviscid flow field through changes in the ratio of specific heats and the viscous equations by changes in the transport as well as the thermodynamic properties of the gas. Within the limitations of hypersonic small disturbance theory the inviscid and viscous equations are formulated with a minimal dependence on Mach number and in a way that brings out their explicit dependence on the thermodynamic and transport properties of the gas. The resulting gas property parameters then are calculated for air-argon mixtures, air-helium mixtures, and frozen dissociate air. These parameters appear to provide a realistic estimate of the effect of a variable atmosphere on surface pressure and heat transfer based on the current series of tests on sharp cones and flat plates in air-argon mixtures and in a low pressure arc tunnel. In addition, the present experiments and comparative experiments in other facilities demonstrate a result of more general interest; namely, that the Mach number is not a dominant parameter in slender body viscous hypersonic aerodynamics. Author (TAB)

N70-39839*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR INVESTIGATION OF A TURBINE WITH TRANSPIRATION-COOLED STATOR BLADES. 1: PERFORMANCE OF STATOR WITH DISCRETE HOLE BLADING
Herman W. Prust, Jr., Harold J. Schum, and Edward M. Szanca Washington Sep. 1970 27 p refs
(NASA-TM-X-2094; E-5550) Avail: NTIS CSCL 20D

The effects of transpiration coolant ejection on stator mass flow and efficiency were experimentally determined for ratios of coolant to primary mass flow from 0 to 7 percent. The results show that transpiration coolant discharge causes a decrease in total mass flow and efficiency. When compared with previously obtained experimental results for trailing-edge discharge, the performance loss for transpiration discharge is significantly larger. The predicted decrease in efficiency resulting from transpiration discharge is less than the experimental decrease. Author

N70-39849*# Translation Consultants, Ltd., Arlington, Va.
INTAKE AND JET EFFECTS OF TWO LIFT FAN CONFIGURATIONS ON FLOW PAST A WING [ZULAUF- UND STRAHLEINFLUESSE ZWEIER HUBGEBLAESEKONFIGURATIONEN AUF DIE FLUEGELSTROEMUNG]
H. Neppert Washington NASA Oct. 1970 55 p refs Transl. into ENGLISH of DGLR Symp. Paper No. 70-008 Presented at Symp. on the Future of Com. Air Transport Technol., Hamburg, 29 Jan. 1970
(Contract NASw-2038)
(NASA-TT-F-13277) Avail: NTIS CSCL 20D

Pressure measurements conducted on two lift fan configurations on a semimodel in a 3-m wind tunnel at a constant incident flow velocity are described. Based on these pressure measurements, normal force and pitching moment distributions of the wing of a VTOL aircraft were determined for different ground distances. The results obtained for both lift fan configurations are compared and discussed. Author

N70-39885# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
THE RESPONSE AND AIRLOADING OF HELICOPTER ROTOR BLADES DUE TO DYNAMIC STALL
Wayne Johnson May 1970 48 p refs
(Contract DA-31-124-ARO(D)-247)
(AD-707939; ASRL-TR-130-1; AROD-4846-11-E) Avail: NTIS CSCL 1/3

An aerodynamic model is constructed for the application of the properties of dynamic stall of airfoils to the calculation of the airloads and blade motion of helicopter rotor blades. Dynamic stall occurs on an airfoil undergoing pitching motion at high angle of attack, and is characterized by peak section lift and moment much larger than the corresponding static stall loads. A method is developed for the solution of the equations of motion of a rotor blade by means of harmonic analysis. The effect of dynamic stall on the blade torsional motion at high advance ratio is examined, and comparison is made with the limited experimental data available. An increase in the dynamic stall angle is shown to significantly decrease the amplitude of the pitch motions. Author (TAB)

N70-39937# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.
NONSTEADY FLOW THROUGH A HEAVILY LOADED ACTUATOR DISK
Jia J. Hu and Yu. K. Hsu Aug. 1969 127 p refs
(Contract N00014-68-A-0512; Proj. Themis)
(AD-708396; TR-16) Avail: NTIS CSCL 1/3

The present investigation is concerned with the non-steady axisymmetric flow of an inviscid, incompressible fluid through a heavily loaded actuator disk. Since the steady state problem is essentially non-linear, a closed form solution is not possible. The small perturbation theory is applied, and the first-order solution is obtained. The resulting perturbation equations which contain the steady state solution as coefficients are solved numerically by using the method of finite differences. The non-steady solutions are compared with the zeroth-order basic solutions. Author (TAB)

N70-39939*# Scientific Translation Service, Santa Barbara, Calif.
QUASI-TWO-DIMENSIONAL FLOW THROUGH A SUPERSONIC CASCADE [ECOULEMENT SUPERESONIQUE QUASI-BIDIMENSIONNEL DANS UNE GRILLE D'AUBES SUPERSONIQUE]
J. Jehl Washington NASA Sep. 1970 16 p refs Transl. into ENGLISH from Rech. Aerosp. (France), no. 3, May–Juin 1970 p 137–143
(Contract NASw-2035)
(NASA-TT-F-13260) Avail: NTIS CSCL 20D

A theoretical scheme is considered in which the influence of the transverse stream contraction in a compressor or turbine cascade on the supersonic flow crossing the cascade is taken into account. The numerical method developed in the theoretical scheme may also be adapted to the case of a flow variation in the stream. Author

N70-40037# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
SYNTHESIS OF AERODYNAMIC FORCE CHARACTERISTICS OF BISYMMETRIC LIFTING VEHICLES

Reinald G. Finke Apr. 1970 31 p refs
(Contract DAHC15-67-C-0011)
(AD-708022; N-595(R); IDA/HQ-68-9485) Avail: NTIS CSCL 22/2

The dependences of lift and drag coefficients on angle of attack for bisymmetric lifting vehicles are synthesized using two simplifying assumptions: (1) the axial force coefficient is independent of the angle of attack, and (2) the normal force coefficient increases linearly with the angle of attack. Good agreement with experimental data is found for the value of the the angle of attack at which the maximum L/D occurs and the angle of attack for maximum C sub L in the hypersonic regime; applicability for subsonic flight is limited to those angles of attack below the inception of flow separation. Conditions for terminal equilibrium glide and landing for aircraft are derived from the simplified aerodynamic characteristics. With the linearized normal force, the following useful rules of thumb are obtained for super and hypersonic vehicles with maximum L/D greater than 1.0: (1) the drag at maximum L/D is very closely twice the zero-lift drag, (2) the L/D at maximum C sub L is about 0.8, (3) the angle of attack for maximum C sub L is about 48 deg, (4) the ratio of the maximum C sub L to the C sub L at L/D max is approximated by 0.5 + L/D(max), and (5) the ratio of the normal force slope to the maximum lift is closely 2.0 per radian. Author (TAB)

N70-40297# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
SOME RECENT EXPERIMENTAL STUDIES ON THE AEROELASTIC STABILITY OF THIN CYLINDRICAL SHELLS. PART 1: AN EXPERIMENTAL STUDY OF THE SUPERSONIC FLOW FIELD OVER AN AEROELASTIC OGIVE CYLINDER MODEL WITH BOUNDARY LAYER CONTROL
Philip L. Dailey, James P. Williams, and Ronald O. Stearman Jan. 1970 151 p refs
(Grant AF-AFOSR-1234-67)
(AD-708485; AFOSR-70-1177TR-Pt-1) Avail: NTIS CSCL 1/3

An experimental study was conducted as the first phase in a program to determine the influence of a compressible viscous boundary layer on cylindrical shell panel flutter. In the first part of the experiment, a study was conducted to provide data on the uniformity of the surface pressure distribution over the region of the flutter model where the thin cylindrical shells were mounted for the flutter experiments. The measured data confirmed that for all flow conditions above Mach Number 1.2, no significant pressure gradient existed over the region of the model where the flutter shells were mounted for testing. A study was then conducted to determine the effectiveness of the boundary layer control system for increasing the boundary layer thickness over the region of the model where the flutter shells were mounted. The boundary layer control system proved to be quite effective and under optimum conditions could increase the displacement and momentum thicknesses by a factor of 10. In general, the displacement and momentum thicknesses could be increased by at least 50% for most of the operating conditions of the wind tunnels by maximum activation of the boundary layer control systems. Finally boundary layer transition and profile similarity studies were conducted to determine the range of free stream flow conditions and boundary layer control activation rates where boundary layer profile similarity could be achieved over the test shell area of the model. The results indicate that similar laminar or turbulent boundary layer profiles can be maintained over the test region of the model for flow conditions where panel flutter can be expected to occur. Author (TAB)

N70-40395*# Scientific Translation Service, Santa Barbara, Calif.
SOME ASPECTS OF THE FLOW OF AN UNSTEADY COMPRESSIBLE LAMINARY BOUNDARY LAYER AROUND A FLAT PLATE [QUELQUES ASPECTS DE L'ECOULEMENT DE COUCHE LIMITE LAMINAIRE COMPRESSIBLE INSTATIONNAIRE AU VOISINAGE D'UN PLAQUE PLANE]
Nadyadour Kh. Zeytounian Washington NASA Oct. 1970 17 p refs Transl. into ENGLISH from Rech. Aerosp. (France), no. 1, Jan.–Feb. 1970 p 16–21
(Contract NASw-2035)
(NASA-TT-F-13256) Avail: NTIS CSCL 20D

A calculation method is presented for the flow of an unsteady compressible laminar boundary layer around a semi-infinite flat plate set in motion, with a velocity U(t) from rest. This method leads to an exact solution of this problem in the form of a power series of the square root of (t), if it is assumed that U(t) can also be developed in a power series of the square root of (t) if t lies within the validity range of the unsteady boundary layer equations. The numerical results obtained show the influence of compressibility on the laminar boundary layer characteristics, as a function of the M infinity, the Mach number of the flow at a large distance from the flat plate. It should be noted that the results of this investigation may be of interest for some unsteady aerodynamics problems, and also be used as tests of numerical computations of more complex compressible boundary layers. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N70-39253# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
THE STABILITY DERIVATIVES OF THE NAVION AIRCRAFT ESTIMATED BY VARIOUS METHODS AND DERIVED FROM FLIGHT TEST DATA
E. Seckel and J. J. Morris Jul. 1970 31 p refs /ts Princeton Univ. Rept. No. 923
Avail: NTIS

For application to a new technique of predicting aerodynamic loads, to determine the accuracy of dynamic stability derivatives as predicted for the North American Navion by several different sources. Using the results of spring 1970 flight tests as the norm, estimates from 1969 wind tunnel tests and several texts were compared and found to be accurate to within the order of 20% with a few exceptions. It is believed that the results can be extended to all single engine light aircraft with straight wing and tail, propeller propulsion, and low power effects. Author

N70-39350# Department of Civil Aviation, Melbourne (Australia).
WAKE TURBULENCE IS DANGEROUS Aviation Safety Digest Publication
[1970] 10 p
Avail: NTIS

The hazards posed by wing tip vortices of large aircraft to light aircraft taking off or landing are discussed. Examples and illustrations of the phenomena are given. Flight rules are suggested for light aircraft to prevent accidents. These rules include: avoidance of flight below and behind large aircraft in the circuit area, assuming a flight path above the settling vortices of large aircraft on takeoff, starting the takeoff run from the end of the runway so as to be airborne before the point where heavy aircraft have lifted off, and maintaining an above and beyond position during final landing approach. Air traffic control procedures are also discussed. E.H.W.

N70-39378*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESCRIPTION OF A DIGITAL COMPUTER PROGRAM FOR AIRPLANE CONFIGURATION PLOTS
Charlotte B. Craidon Washington Sep. 1970 85 p
(NASA-TM-X-2074; L-7149) Avail: NTIS CSCL 01C

A computer program (D2290) is presented which generates the necessary instructions for automatic plotting of the numerical model of an airplane configuration. Program options may be used to draw three-view and oblique orthographic projections, as well as perspective projections of an airplane. These plots are useful in checking the accuracy of the numerical model data. Magnetic tape output from this program was used to drive a CalComp plotter and a Gerber plotter. The program was also used for online display of a configuration on a cathode ray tube device. Author

N70-39605*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SPACE SHUTTLE RELATED MAINTENANCE EXPERIENCE WITH THE X-15 AIRCRAFT
Vincent N. Capasso, Jr. *In its* Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 33–44 (See N70-39603 22-31)
Avail: NTIS CSCL 01C

Discussed is the maintenance activity between X-15 flights and the number and types of repair items which would be related to space shuttle requirements. The increased size and complexity of the shuttle systems will magnify the number of repair items, making the required turnaround time difficult or impossible to achieve unless careful consideration is given to problem prevention and access for system repair and maintainability. Author

N70-39639# Liege Univ. (Belgium).
REQUIREMENTS POSED BY HIGH SPEED FLIGHTS [EXIGENCES POSEES P^R LES VOLS A GRANDE VITESSE]
Jacques Ducarme *In* AGARD Fuels, Lubricants, and Auxiliary Fluids for Supersonic and Hypersonic Aviation Jun. 1970 p 1–28 refs In FRENCH (See N70-39638 22-18)
Avail: NTIS

The usefulness of a standard atmosphere is discussed. Elements of fluid flow are considered, including boundary layer flow, the forces of friction, supersonic flows, and hypersonic flows. Thermal aspects examined include thermal equilibrium of an engine in flight, ways to limit kinetic heating effects on the engine, the conditions imposed by kinetic heating, and thermal stability of the fuel. Problems in very high speed propulsion are discussed, such as the choice of system to use, the influence of high speed flight on propulsion system functioning, and ways to organize and maintain combustion in very high speed flow. Transl. by P.A.B.

N70-39664# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
AIR FORCE AIRCRAFT STRUCTURAL INTEGRITY PROGRAM: AIRPLANE REQUIREMENTS
Harold M. Wells, Jr. and Troy T. King May 1970 51 p
(AD-707884; ASD-TR-66-57) Avail: CFSTI CSCL 1/3

The report summarizes requirements for the airplane portion of the Aircraft Structural Integrity Program based upon the results of experience and events since the inception of the program in 1958. It supplements the detailed structural specifications for Air Force airplanes and updates Aeronautical Systems Division Technical Report 66-57, dated January 1966. Applicable military specifications are referenced throughout. Author (TAB)

N70-39729# Bell Helicopter Co., Fort Worth, Tex.
A STABILITY AND CONTROL PREDICTION METHOD FOR HELICOPTERS AND STOPPABLE ROTOR AIRCRAFT. VOLUME 1: ENGINEER'S MANUAL Final Report
Charles L. Livingston Feb. 1970 89 p refs
(Contract F33615-69-C-1121)
(AD-707881; AFFDL-TR-69-123-Vol-1) Avail: NTIS CSCL 1/3

This report describes a mathematical model of rotorcraft that may be used to determine characteristics of performance, stability, response, and rotor blade loads. The complexity of the equations used requires the use of a digital computer for efficient solution. This four volume report describes the computer program in detail and illustrates the method of computing rotorcraft characteristics by specific example. Author (TAB)

N70-39844# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Hypersonic Research Lab.
SOME DESIGN ASPECTS OF HYPERSONIC VEHICLES Final Report
Wilbur L. Hankey Mar. 1970 71 p refs
(AD-708133; ARL-70-0049) Avail: NTIS CSCL 1/3

Some design concepts of hypersonic vehicles are present including fundamental high velocity flight mechanics, prediction of hypersonic aerodynamic characteristics, and the optimization of hypersonic lifting bodies and hypersonic cruise vehicles. The material represents that which was given in lecture form at the von Karman Institute for Fluid Dynamics, Brussels, Belgium as part of a short course on Hypersonic Aircraft to engineers of the NATO countries on 19-23 Jan 70. Author (TAB)

N70-40002# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Section.
A FLIGHT INVESTIGATION OF LATERAL-DIRECTIONAL HANDLING QUALITIES FOR V/STOL AIRCRAFT IN LOW SPEED MANEUVERING FLIGHT Final Report, Aug. 1968–Aug. 1969
K-H. Doetsch, Jr., D. G. Gould, and D. M. McGregor Wright-Patterson AFB, Ohio AFFDL Mar. 1970 62 p refs
Prepared for Cornell Aeron. Lab., Inc.
(Contract AF 33(615)-3736)
(AD-707831; LTR-FR-12; AFFDL-TR-69-41) Avail: NTIS CSCL 1/3

An investigation to determine the ranges of various lateral directional characteristics required to provide adequate flying qualities for turning maneuvers at low speed was undertaken using an airborne V/STOL aircraft simulator. Five parameters were varied in a systematic manner: the damping ratio, the frequency, and the ratio and the frequency of the numerator of the roll-angle to aileron-control-input transfer function. The pilots performed a low speed, visual maneuvering task and documented their assessment of the characteristics through extensive comments and a numerical rating. The report presents all the data categorized with respect to the test parameters. Author (TAB)

N70-40069# National Aerospace Lab., Amsterdam (Netherlands).
FATIGUE LOAD MONITORING OF MILITARY AIRCRAFT
Paris AGARD Aug. 1970 9 p ref
(AGARD-AR-28) Avail: NTIS

The results of a study on fatigue level control are summarized, and include current monitoring, measurement, and analysis techniques along with major problems and needs. The following conclusions were reached: For present-day aircraft the monitoring of fatigue loads appears to be mandatory. The monitoring systems used at present measure and record movement parameters. The conversion of these parameters to structural loads or stresses may be difficult for more complex aircraft. The monitoring of strains instead of c.g. acceleration should be preferred with complex aircraft where no consistent relation between acceleration and structural load can be taken to exist. It is recommended that efforts to develop a simple strain recording system should be encouraged. Within the the NATO countries with relatively large air forces, well-established techniques for fatigue life monitoring exist, which

are adapted to their specific demands and problems. It is recommended that the smaller NATO countries coordinate their efforts to arrive at a solution which suits their joint requirements.
Author

N70-40109# Institute for Defense Analyses, Arlington, Va.
A BIBLIOGRAPHY ON AIR TRAVEL AND ASSOCIATED GROUND TRANSPORTATION: URBAN MASS TRANSPORTATION PROJECT
Janet D. Kiernan Jun. 1970 48 p refs
(Contract DAHC15-67-C-0011; DOT-UT-43(IAA))
(AD-708023; N-731(R); IDA/HQ-70-11522) Avail: NTIS CSCL 1/2

A survey of documents and articles was made to help identify current data and studies relating to air travel demand projections, alternative airport configurations, flow patterns and rates, and available or potential ground transportation concepts, systems, and components. The bibliography covers the subject areas up to August 1969.
Author (TAB)

N70-40188# Franklin Inst., Philadelphia, Pa. Research Labs.
EXPERIMENTAL SYSTEMS FOR IMPACT PROTECTION Final Report, Sep. 1969 – Mar. 1970
F. W. Cooke, B. L. Rosenberg, and M. G. Kelley 16 Apr. 1970 40 p refs
(Contract N00156-70-C-1192)
(AD-708017; FIRL-F-C2636; NADC-AC-7003) Avail: NTIS CSCL 1/3

The impact absorbing properties of starch/brine dilatant suspensions were characterized with an instrumented, pendulum-type impact tester. The starch concentrations were varied between 47.5 and 52.5% and sealed in heavy rubber bags of varying thickness. The temperature of the filled rubber bags was varied between 45 and 110F. Impacting energies ranged between 30 and 141 ft-lbs with velocities of 11 and 17 ft/sec. The dilatant suspensions were found to be highly efficient and reusable energy absorbers under all test conditions. Impactor penetration, peak deceleration, and jerk varied depending on the impact energy input, impact velocity, bag wall thickness, and, to a lesser extent, starch concentration and temperature. The filled bags readily conform to the shape of a 1 cm radius impactor and yield relatively low peak deceleration and jerk. There was no noticeable deterioration of the dilatant properties as a result of temperature cycling and repeated impacts.
Author (TAB)

N70-40194# Raven Industries, Inc., Sioux Falls, S.Dak.
FABRICATION AND FLIGHT TEST OF POLYOLEFIN BALLOON Final Report, 15 Nov. 1969 – 30 Jun. 1970
Roger K. Engel, Jack D. Beemer, and Mike S. Pavey 30 Jun. 1970 23 p refs
(Contract N00014-70-C-0103)
(AD-708753; R-0573017) Avail: NTIS CSCL 1/3

A thorough analysis of the failure mode and stresses is detailed showing forces in the upper region of the balloon. Program conclusions and recommendations are listed.
Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N70-39278*# National Aeronautics and Space Administration, Washington, D.C.
HIGH-POWER, LONG-LIFE ELECTRICAL GENERATING SYSTEMS FOR LUNAR BASE MISSIONS
Paul R. Miller *In its* Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 11-21 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 10B

Nuclear and solar cell systems are potential power system candidates. An updated comparison of the primary performance characteristics of these two system types is presented. The effects of possible lunar base mission constraints and requirements identified from previous studies on these characteristics are then reviewed.
Author

N70-39367 Thermo Electron Engineering Corp., Waltham, Mass.
PERFORMANCE OF A THERMIONIC CONVERTER WITH A NOMINAL SINGLE-CRYSTAL (110) TUNGSTEN EMITTER AND A NIOBIUM COLLECTOR
D. Lieb, A. Donaker, and F. Rufeh Dec. 1969 72 p refs
(Contract AT(30-1)-3874)
(TEE-3874-8; TE-4122-84-70) Avail: NTIS

The performance of a variable-spacing converter with a specially-prepared (110) tungsten emitter and a niobium collector was recorded for the emitter temperature range of 1600 to 2000 K and an interelectrode spacing range of 0.5 to 40 mils. These data, though not from an exact (110) emitter, still show a higher output power than data from a chloride tungsten emitter. It appears that further increases in performance can be obtained by improving vapor deposition techniques. The work function of this niobium collector is in agreement with data from a molybdenum collector surrounded by niobium getters, and is higher by 0.1 eV than similar data from a molybdenum collector without niobium getters.
Author (NSA)

N70-39388*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
REVIEW OF THE BRAYTON ENGINE ELECTRICAL SUBSYSTEM DESIGN AND COMPUTERIZED TECHNIQUE USED TO DOCUMENT WIRING
James Nestor and Pierre A. Thollot Washington Sep. 1970 42 p refs
(NASA-TM-X-2079; E-5621) Avail: NTIS CSCL 10B

A general description of the Brayton-B engine space power system is presented, with special emphasis on the electrical subsystem. The interval between delivery of individual components and the initiation of systems testing is covered in detail, with particular attention to the computer-oriented approach used to document all the many interconnections of the electrical components. Applications of the documentation technique are recommended for development of other complex electrical - electronic systems.
Author

N70-39507*# Heliotek, Sylmar, Calif.
DEVELOPMENT OF AN INTEGRATED LIGHTWEIGHT FLEXIBLE SILICON SOLAR CELL ARRAY Final Report
E. L. Ralph, E. F. Zimmerman, and P. M. Stella 12 Sep. 1970 121 p Prepared for JPL
(Contracts NAS7-100; JPL-952660)
(NASA-CR-113568) Avail: NTIS CSCL 10B

Methods and analytical techniques were investigated for fabricating an integrated lightweight flexible silicon solar cell array blanket. The array is to be capable of providing 120 watts per pound of array weight, being manufactured at a cost of $100 per watt of raw power, and being produced in modular prefabricated sections. The study effort was divided into seven major tasks in order to examine individual components comprising the total array concept.
Author

N70-39508*# General Electric Co., Philadelphia, Pa.
POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT Quarterly

Technical Reports
R. Andrews, R. Andryczyk, S. Capodici, T. Ebersole, A. Kirpich et al 1 Aug. 1970 235 p refs Prepared for JPL
(Contracts NAS7-100; NPL-952536)
(NASA-CR-113603; Rept-1J86-TOPS-555; QTR-1; QTR-2) Avail: NTIS CSCL 10B

The design and development of the electrical systems and the power conditioning equipment for the thermoelectric outer planet spacecraft program is discussed. Breadboard designs of various conditioning and switching elements are described. Satisfactory test demonstrations were completed on a number of units. Author

N70-39524# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
IMPROVEMENT IN CdS THIN FILM SOLAR CELL Final Technical Report, 1 Nov. 1967 – 1 Nov. 1969
W. F. Dunn and H. E. Nastelin Wright-Patterson AFB, Ohio ARL Mar. 1970 82 p
(Contract F33615-68-C-1182)
(AD-707869; ARL-70-0036) Avail: NTIS CSCL 10/2

The report is concerned with two areas in the cadmium sulfide solar cell development program: (1) a program of flight panel construction for satellite and balloon testing of CdS solar cells and (2) a developmental effort for improving the stability and efficiency of the CdS solar cell. Experimental CdS solar cells panels are being tested on the OV1-13 and OV1-17 satellite experiments. The developmental effort was concentrated into the following areas: (1) contact resistance measurements made on the CdS current collector grid adhesive, (2) an optimization of the CdS cell for good low light level performance, (3) an optimization of the Cu2S barrier formation process and (4) an investigation of copper nodules found on CdS cells that had been degraded in the open circuit voltage mode. TAB

N70-39623*# Hughes Aircraft Co., El Segundo, Calif.
ELECTRIC THRUSTER POWER CONDITIONER Quarterly Technical Report, 30 Sept. 1969 – 26 Aug. 1970
26 Aug. 1970 48 p Prepared for JPL
(Contracts NAS7-100; JPL-952297)
(NASA-CR-113594; Rept-2228/1157) Avail: NTIS CSCL 10B

Modifications to breadboard models of an electric thruster power conditioner system to change the system from oxide to hollow cathode design are described. The support equipment and the acceptance tests performed on the modified model are also described. E.H.W.

N70-39643*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE POWER AND ELECTRIC PROPULSION SYSTEM SRT
In its Res. and Advanced Develop., Vol. 2 15 Feb. 1970 p 1 – 217 refs (See N70-39642 22-34)
Copyright. Avail: NTIS HC $10.00/MF $0.65 CSCL 10B

Research progress is reported on electric engine systems, nuclear electric power systems, solar power generation systems, and chemical power generation systems for spacecraft propulsion and operation. R.B.

N70-39718*# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS Quarterly Report, 1 Jan. – 31 Mar. 1970
John O'M. Bockris 31 Mar. 1970 30 p refs
(Grant NGR-39-010-002)
(NASA-CR-113599) Avail: NTIS CSCL 10C

Research on reversibility of organic reactions, oxygen dissolution reaction, and zinc electrode are reported. The efficiency of a rhodizonic acid graphite paste electrode with a new cell was tested, and the discharge characteristics of the electrode with Pt as a counter electrode are given. The initial state of the oxygen dissolution reaction was studied in detail, and it was determined that the effect of the solvent also has to be taken into account. Ellipsometric investigations of organic adsorption were made, in order to understand dendrite growth inhibition on zinc electrodes for silver zinc batteries, but were found to give no results. N.E.N.

N70-39764*# Atomics International, Canoga Park, Calif.
TESTING OF A CASCADED THERMOELECTRIC MODULE Final Report
N. C. Miller 14 Jul. 1970 14 p ref
(Contract NAS3-13452)
(NASA-CR-72700; AL-70-56) Avail: NTIS CSCL 10B

The life testing of a cascaded thermoelectric converter, which had been fabricated and tested to 3450 hours, was extended to about 3930 hours. At that time, the coolant pump of the heat rejection system failed, resulting in severe damage to the module. The test was subsequently terminated. During the first 450 hours of testing, the power output of the module remained essentially constant. Author

N70-39834# Sydney Univ. (Australia) School of Electrical Engineering.
ENERGY CONVERSION RESEARCH GROUP Annual Report
May 1969 40 p
(NP-18242; ECG-07) Avail: AEC Depository Libraries

Progress in the areas of energy conversion studies, induction plasma and shock wave studies, and arc studies and synthetic testing, is discussed. Particular emphasis is placed on magnetohydrodynamics. NSA

N70-39884*# General Electric Co., Schenectady, N.Y.
OPERATION OF A THERMIONIC CONVERTER WITH A (112) TO (114) ORIENTED TUNGSTEN EMITTER AND A NIOBIUM COLLECTOR WITH OXYGEN PRESENT
V. C. Wilson and S. P. Podkulski Washington NASA Sep. 1970 78 p refs
(Contract NAS3-8511)
(NASA-CR-1661; GESP-9006) Avail: NTIS CSCL 10B

A parallel plane, variable spaced, thermionic converter with a fluoride vapor deposited emitter, a niobium collector and a niobium guard ring was built and tested. Current-voltage characteristics were obtained for a range of emitter temperatures from 1670 to 2153 K, collector temperatures from 773 to 1073 K, cesium reservoir temperatures from 513 to 641 K, and spacings from 2 to 20 mils. The results are compared to those of a converter using a polycrystalline tungsten emitter and a niobium collector. Author

N70-39930* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MISSILE STAGE SEPARATION INDICATOR AND STAGE INITIATOR Patent
James W. Mayo and James E. Michael, inventors (to NASA) Issued 18 Jan. 1966 (Filed 27 Feb. 1964) 7 p Cl. 102-49
(NASA-Case-XLA-00791; US-Patent-3,229,636;
US-Patent-Appl-SN-347960) Avail: US Patent Office CSCL 16A

Piezoelectric means are employed to separate two stages of a missile, to initiate the operation of the upper stage upon its separation from the lower stage, and to produce ground indications that the rocket motor has burned out and that the two stages are separated. The piezoelectric generator and control circuit are described; pulses generated across electrical leads perform the necessary functions. Relatively few parts are necessary to obtain initiation; the means utilized are also insensitive to vibration and to altitude and are safe with relation to the use of live power sources. P.A.B.

N70-39998# Los Alamos Scientific Lab., N.Mex.
SPACE ELECTRIC POWER R AND D PROGRAM, PART 1 Quarterly Status Report, Period Ending 30 Apr. 1970
May 1970 6 p refs
(Contract W-7405-eng-36)
(LA-4446-Pt-1) Avail: NTIS

Development and testing of a thermoelectric module for direct conversion of heat to electricity is reported. Information is included on potassium-input heat pipe, heat-pipe radiator system development, mercury radiator heat pipe, phenyl ether radiator heat pipes, and mercury input heat pipes. NSA

N70-40031# General Electric Co., Philadelphia, Pa.
OPTIMIZATION OF A LINEAR NON-EQUILIBRIUM MHD GENERATOR
S. Zauderer Jun. 1970 22 p refs *Its* ONR Tech. Rept. No. 15
(Contract Nonr-3867(00))
(AD-707803; DOC-70SD261) Avail: NTIS CSCL 10/2

Based on the results of an experimental study of a supersonic, non-equilibrium MHD generator, a theoretical optimization of such a generator was performed. It was found that neon seeded with less than 0.1% cesium was the optimum generator working fluid. The maximum generator power output and efficiency was obtained in a constant current density generator operating with a favorable pressure gradient. The optimum channel geometry had an exit to entrance area ratio of about six, linearly diverging channel walls, and a length to average diameter ratio of about ten. It was also shown that a constant velocity generator with a linearly diverging channel geometry had a very low generator conversion efficiency. Author (TAB)

N70-40339# Naval Research Lab., Washington, D.C. Solid State Technology Branch.
AN ASSESSMENT OF HIGH-VOLTAGE DC ELECTRICAL POWER IN AIRCRAFT ELECTRICAL SYSTEMS Interim Report
S. J. Wilson and J. P. O'Connor 1 Jul. 1970 14 p refs
(AD-709079; NRL-7126) Avail: NTIS CSCL 10/2

If the presently installed three-phase ac transmission system on aircraft were replaced by a higher voltage dc (HVDC) transmission using a ground return (the aircraft frame), a reduction in weight of wiring, number of wires, and total power losses equal to one-third their present value could be achieved at a dc system voltage of 345 V. A plot of system wire weight vs values of dc system voltage shows an increase in wiring weight with decreasing values of dc system voltage. The weight reduction with increasing values of voltage is significant because the distribution wiring weight is about from one- to two-thirds of the total electrical system weight. HVDC may have some disadvantages such as higher short-circuit currents, some increase in personnel hazard, and at present a limitation on the use of transistors. The compromise between the weight advantages to be gained at 345 V and the disadvantages that were anticipated at this value leads to the choice of a standard value of 230 V. At this voltage, a saving of approximately 50% in wire weight and 50% in power losses results when compared to the ac systems on WF-2 and F4J aircraft. Author (TAB)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N70-39004# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
SPECTRAL MODIFICATIONS IN UV IRRADIATED SOLUTIONS OF T2 PHAGE DNA
M. Cremonese, G. Giampaoli, M. Matzeu, and G. Onori 22 Sep. 1969 30 p refs
(ISS-69/38) Avail: NTIS

The modification produced by UV radiation on the native DNA of the T2 phage is presented. The spectral modifications produced in the absorption spectra of the irradiated solutions are revealed. These modifications reach values of approximately 10%. We observe a lowering of the O. D. in the wavelength range 2400 < lambda < 3000 A, with a maximum at lambda approximately equals 2700 A; it corresponds to the disappearance of the thymine molecule. Vice versa there is an increase of the O. D. at lambda >3000 A, which indicates the presence of photoproducts with an absorption maximum at lambda = 3250 A. From the interpretation of the spectra, the formation of thymine dimers and of another photoproduct can be seen. For low doses of radiation the thymine dimers are predominant but at high doses the opposite occurs. This procedure allows an evaluation of the cross sections for the photoproduct formation at the wavelengths of irradiation. Author

N70-39029# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
SECOND PROGRAMMING COURSE ON THE APPLICATIONS OF ELECTRONIC COMPUTERS IN BIOLOGY AND MEDICINE. PART II: EXERCISES OF STATISTICS
25 Jan. 1969 57 p In ITALIAN; ENGLISH summary
(ISS-69/10) Avail: NTIS

Exercises in statistical problems are presented by analyzing the birth weight of males with six months gestation. Topics discussed include: variational analysis, regression analysis, and statistical distributions. Results are tabulated. Transl. by F.O.S.

N70-39081 Wisconsin Univ., Madison.
AEROBIC AND ANAEROBIC PERFORMANCE CHARACTERISTICS OF CHAMPION RUNNERS AT SEA LEVEL AND MODERATE ALTITUDE
Jack Tupper Daniels (Ph.D. Thesis) 1969 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-12353

Twenty-four middle-distance runners, in training for the 1968 Olympic Games in Mexico City, were studied at sea level and at a 7300-foot altitude. Various physiological adjustments to different initial running speeds were measured while the subjects ran on a 400-meter track. Oxygen costs for the various intensities of work were estimated, and by subtracting the measured values for oxygen consumption, oxygen deficits were calculated. Increased speeds at the start of running were accompanied by increased rates of aerobic metabolism. Therefore, the initial oxygen deficits did not vary significantly with changes in first-lap running speeds from as much as five seconds slower to five seconds faster than race pace, as long as the race pace was within the aerobic capacity of the subjects. Among milers, starting speeds of five seconds faster than race pace resulted in greater O2 deficits than those related to initial laps four to five seconds slower than race pace. Dissert. Abstr.

N70-39162# Sloan-Kettering Inst. for Cancer Research, New York.
THE BIOLOGICAL EFFECTS OF TRITIUM
Helen Q. Woodard AEC 18 May 1970 49 p refs
(HASL-229) Avail: NTIS

A literature survey is presented on the following topics: tritium hazards to personnel of nuclear reactors; hazards to populations following nuclear explosions; hazards to personnel in biological and medical research; uptake and loss of tritiated water; incorporation of tritium from HTO into body components; model for computing radiation dose from acute acquisition of tritium as HTO by man; nature of biological effects of tritium; and mechanisms of biological

effects of tritium. It is concluded that the types of possible human exposure to tritium fall into the following groups: acute exposure to large concentrations of tritiated water or tritium gas during accidents at nuclear reactors or during the manufacture of tritiated compounds; chronic exposure to low levels of activity in contaminated environments; and acquisition of tritiated compounds by laboratory personnel through accidental ingestion, injection, inhalation, or contamination of the skin. NSA

N70-39191# California Univ., Berkeley. Lawrence Radiation Lab.
GENERATOR-PRODUCED KRYPTON-81m FOR DYNAMIC STUDIES OF THE LUNGS AND HEART WITH THE SCINTILLATION CAMERA
Y. Yano, J. McRae, and H. O. Anger Apr. 1970 11 p refs Presented at Prepn. and Control of Radiopharmaceuticals Conf., Vienna, 11 – 15 May 1970 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-19785; Conf-700517-2) Avail: NTIS

Krypton-81m is obtained in multimillicurie amounts from its cyclotron-produced parent isotope 4.7-hr Rb-81. The 13-sec Kr-81m daughter decays by isomeric transition and emission of a monoenergetic 190-keV gamma which is 35% internally converted. Dynamic perfusion studies are done with Kr-81m by injecting the sterile saline-Kr-81m solution intravenously and taking 1- to 3-sec exposures with the scintillation camera. Blood flow through the right heart, pulmonary arteries, and lungs is visualized. Krypton-81m is obtained as a gas from the same generator system by eluting the dry resin column with air. This mixture of Kr-81m and air is inhaled by the patient to provide ventilation and exchange studies of the lungs. Five to six mCi of Kr-81m can be given every few minutes to obtain different views or to repeat studies of patients. The high photon yield, moderate gamma ray energy for scintigraphy, and short half-life (which keeps the radiation dose to a low level) make Kr-81m an ideal radionuclide for dynamic studies with the scintillation camera. NSA

N70-39201# Joint Publications Research Service, Washington, D.C.
SPACE BIOLOGY AND MEDICINE, VOLUME 4, NO. 3, 1970
4 Sep. 1970 143 p refs Transl. into ENGLISH of the periodical "Kosmicheskaya Biologiya i Meditsina" Moscow, Medgiz., 1970 p 1 – 88
(JPRS-51315) Avail: NTIS

The results of investigations related to aerospace medicine are reported, including life support systems, hypokinesia effects on organisms, radiation effects on biological and physiological functions, medical monitoring systems and bioinstrumentation, and acceleration effects on the vestibular function in animals. For individual titles, see N70-39202 through N70-39223.

N70-39204# Joint Publications Research Service, Washington, D.C.
COMBINED EFFECT OF ACUTE HYPOXIA AND HIGH AMBIENT TEMPERATURE ON ANIMALS
A. V. Sergiyenko *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 18 – 26 refs (See N70-39201 22-04)
Avail: NTIS

Experiments were carried out to study the combined effect of acute hypoxia increasing at different rates (2 to 500 m/sec) and different ambient temperatures (+21, 30 and 40 C) on the altitude tolerance of test animals. The tolerance was evaluated by the altitude ceiling and survival time of animals at 12,000 m and during simulated ascent at a rate of 2 to 500 m/sec. An increase in ambient temperature induced a substantial decrease in altitude tolerance due to significant disturbances in the regulatory and compensatory mechanisms resulting from the combined effect of high temperature and hypoxia increasing at different rates. An increase in the decompression rate caused an increase in the altitude ceiling and a progressive decrease in the duration of normal activity and survival at an altitude of 12,000 m. Author

N70-39205# Joint Publications Research Service, Washington, D.C.
DYNAMICS OF CHANGES IN PROTEIN METABOLISM IN RATS DURING PROLONGED HYPOKINESIA
I. V. Fedorov et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 27 – 31 refs (See N70-39201 22-04)
Avail: NTIS

Each rat was placed in an individual open-air compartment of a special metabolism cage fabricated from plastic materials. The tail of each rat was held to a metal pin in the cage by adhesive plaster. A plaster jacket was fitted onto each animal for immobilizing it. The jackets were cast from plastic models of the rats and corresponded to the size of the test animals. Only the snouts and front legs of the rats remained relatively free. The animals became less active with time while immobilized. In some animals bloody crusts appeared around the nose and eyes. When removed from the cages upon termination of the experiment the animals were seriously emaciated. Their fur was dishevelled, filthy in places, and was not securely attached to the skin. Their movements were constrained and unsure. Author

N70-39206# Joint Publications Research Service, Washington, D.C.
MORPHOLOGY OF THE KIDNEYS AND NEUROSECRETORY SUBSTANCE OF THE POSTERIOR LOBE OF THE HYPOPHYSIS IN RATS AFTER PROLONGED EXPOSURE TO TRANSVERSE ACCELERATION
A. S. Pankova et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 32 – 39 refs (See N70-39201 22-04)
Avail: NTIS

The morphological changes in the kidneys and neurohypophysis revealed a certain parallelism. Ejection of the neurosecretion preceded the appearance of morphological symptoms which reflected an increased reabsorption of water in the kidneys. The intensity of morphological changes in the neurohypophysis-kidney system was dependent on the time of exposure to accelerations. Author

N70-39207# Joint Publications Research Service, Washington, D.C.
IMMUNOBIOLOGICAL REACTIVITY OF MICE AT AN ALTITUDE OF 3000 METERS
A. S. Kaplanskiy et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 40 – 44 refs (See N70-39201 22-04)
Avail: NTIS

The phagocytic activity of blood neutrophils and abdominal macrophages and the antibody production of mice immunized with a killed typhoid vaccine or Vi-antigen (immunization performed on the eighth day of the exposure) remained normal. The intensity of plasma cell hyperplasia occurring in the regional lymph nodes of the immunized animals also remained unaltered. A decline in lymph node weight observed at the end of the experiment was due to a decrease in the lymphocyte count. Author

N70-39208# Joint Publications Research Service, Washington, D.C.
ELECTRON MICROSCOPE STUDY OF STRUCTURE OF THE PULMONARY ALVEOLAR AND CAPILLARY WALLS DURING STRESS
R. S. Morozova et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 45 – 53 refs (See N70-39201 22-04)
Avail: NTIS

The results of a comparative electron microscope examination of the air-blood barrier in the lungs of mammals kept under normal

conditions, exposed of transverse accelerations, and kept under conditions of mechanically modified pulmonary circulation are given. The latter changes are similar to those developing in response to acceleration. Under normal conditions the air-blood barrier is continuous, consisting of the alveolar epithelium, capillary endothelium, and the basal membrane situated between them. Under conditions of transverse accelerations and modified hemodynamics the structure of the air-blood barrier undergoes significant changes involving an increase in barrier thickness due to the development of collagen fibrils between the epithelium and endothelium. Author

N70-39209# Joint Publications Research Service, Washington, D.C.

DNA SYNTHESIS AND RATE OF BONE MARROW CELL DIFFERENTIATION IN DOGS EXPOSED TO RADIATION SIMULATING EXTENDED SPACE FLIGHT

A. V. Ilyukhin *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 54–61 refs (See N70-39201 22-04)

Avail: NTIS

The irradiation pattern simulated the environment in space cabins during extended space flights. The dogs were irradiated for 12 to 16 months. The tested parameters changed insignificantly and reversibly during single 50-rem irradiations of the animals. No significant changes in DNA synthesis or the rate of cell maturation occurred during chronic irradiations of the animals with total of 25, 75, and 150 rem per year. Author

N70-39210# Joint Publications Research Service, Washington, D.C.

COMPARATIVE EVALUATION OF RADIOBIOLOGICAL EFFECTS OF VARIOUS TYPES OF PARTIAL PROTECTION

Yu. G. Grigoryev et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 62–69 refs (See N70-39201 22-04)

Avail: NTIS

The effectiveness of partial body protection of dogs irradiated by 250 MeV protons at the minimum absolutely lethal dose (350 rad) is discussed. Paraffin blocks were used for shielding 15 percent of the body: head, chest, upper and lower abdomen, pelvic region or hind legs. The partial protection of any part of the body appeared effective and all the experimental animals survived. The effect was most pronounced when the chest and pelvis were shielded. A distinct relationship was discovered between the effect of partial body protection and the amount of shielded bone marrow. Author

N70-39212# Joint Publications Research Service, Washington, D.C.

SOME ASPECTS OF MEDICAL SUPPORT FOR PROLONGED SPACE FLIGHTS

G. L. Yaroshenko et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 79–82 refs (See N70-39201 22-04)

Avail: NTIS

Minimum requirements for medical support can be determined on the basis of a prediction of space crew morbidity. Most stress factors inherent in space flights occur on the earth, causing disorders in healthy persons. Accordingly, disturbances and diseases developing in subjects who have long worked under stress conditions or who have been exposed to simulated stress effects may be used as reference data for pertinent predictions. A method is suggested for predicting disturbances and diseases during prolonged space flights. The method may help in determining the medical items which must be included in space kits, ascertaining the degree to which cosmonauts should receive medical training, and developing recommendations on medical equipments. Author

N70-39213# Joint Publications Research Service, Washington, D.C.

USE OF THERMAL STRESS AS A FUNCTIONAL-DIAGNOSTIC TEST IN EXAMINING COSMONAUTS

Ye. I. Kuznets et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 83–89 refs (See N70-39201 22-04)

Avail: NTIS

In examining cosmonauts it is proposed that they be exposed in a medium with a temperature of about 50 deg with a relative humidity of 85 to 90%, this constituting a functional and diagnostic test. Thermal tolerance can be evaluated on the basis of heart rate, arterial pressure, rectal temperature, water losses, accumulated heat, and exposure time. The values of these parameters established as the limit of human thermal tolerance are given. Author

N70-39214# Joint Publications Research Service, Washington, D.C.

PRELIMINARY PHYSICAL TRAINING AS A FACTOR INCREASING TOLERANCE TO WATER IMMERSION

Ye. I. Kuznets et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 90–97 refs (See N70-39201 22-04)

Avail: NTIS

Nine health test subjects 22 to 32 years old were exposed to a 24-hour water immersion experiment before and after a special physical training program which involved various exercises to increase general endurance and strength. It was shown that general and static endurance, strength, speed, cardiovascular, and respiratory responses to maximum speed and dynamic loads were more stable in water immersion experiments which followed physical exercises. Author

N70-39215# Joint Publications Research Service, Washington, D.C.

EFFECT OF CYCLIC ATMOSPHERIC CHANGES ON HUMAN BASAL METABOLISM DURING PROLONGED HYPOKINESIA

G. F. Makarov *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 98–102 refs (See N70-39201 22-04)

Avail: NTIS

Two health test subjects were confined to an altitude chamber for 35 days. The experiment consisted of five cycles lasting seven days each. On the third day the atmosphere was hypoxic (PO2 = 110 + or – 5 mm Hg), on the fourth day it was hypoxic (PO2 = 110 + or – 5 mm Hg) and hypercapnic (PO2 = 15 + or – 3 mm Hg), on the seventh day it was hyperoxic (PO2 = 320 + or – 10 mm Hg) and on the remaining days a normal atmosphere was maintained. The results of the preliminary experiments suggest that cyclic alternations of hypoxia and hypoxia combined with hypercapnia may give a stimulating effect which compensates for a hypokinesia-induced decline in metabolism. Author

N70-39216# Joint Publications Research Service, Washington, D.C.

EFFECT OF A REDUCED DIET AND HYPOKINESIA ON HUMAN TOLERANCE TO STATIC LOADS

M. A. Cherepakhin *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 103–110 refs (See N70-39201 22-04)

Avail: NTIS

Three series of experiments, each 15 days in duration were run on 18 subjects in the age group 24 to 27 years. In all the experiments the subjects were fed a ration 1600 cal/day consisting of lyophilized foods. The first series the motor activity regime was unrestricted. In the second series the subjects adhered to a rigorous bed confinement. In the third series the conditions differed from those in the second in that before and after the experiments the test subjects were exposed to accelerations in a chest-to-back direction (8 g) for a period of 120 seconds. A diet of lyophilized foods with a normal motor activity regime exerts no effect on

human tolerance to static loads. Hypokinesia in the form of bedrest confinement for 15 days with a diet of lyophilized foods in a quantity of 1800 cal/day exerts a negative effect on human tolerance to stress. A static functional test is recommended for predicting human tolerance to accelerations. The test can be made in small-volume chambers, in bed, in a fixed position, or in a spacesuit.
Author

N70-39219# Joint Publications Research Service, Washington, D.C.
USE OF HYPOTHERMIA FOR PREVENTING THE NEGATIVE EFFECT OF OXYGEN INADEQUACY ON VESTIBULAR RELFEXES
I. I. Voinova *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 120–123 refs (See N70-39201 22-04)
Avail: NTIS

Nystagmus and respiration rate in response to adequate stimulation of the vestibular apparatus were investigated in 60 white rats subjected to hypothermia. The rats were placed on a special electrically rotated stand with a wide range of angular accelerations and the reactions were registered on an encephalograph. The experiments reveal that the intensity of the vestibular reactions in the cooled rats is considerably reduced in comparison with the reactions for intact animals. The reactions did not differ significantly before and after exposure to a simulated altitude of 15,000 m. After the rats are warmed, the reaction is restored to the initial level after 40 to 50 minutes. The number and duration of nystagmoidal movements in uncooled animals almost doubled in a rarefied atmosphere, and the reaction has not returned to normal 1.5 hours after removal from the pressure chamber. The mortality rate among animals cooled to 25 deg was half that of intact animals at an altitude of 13,000 m. R.B.

N70-39220# Joint Publications Research Service, Washington, D.C.
ELECTRIC REACTIONS OF VASOMOTOR NEURONS TO DIRECT STIMULATION OF THE VESTIBULAR NERVE IN CATS
R. A. Grigoryan et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 124–129 refs (See N70-39201 22-04)
Avail: NTIS

The reaction of the vasomotor neurons in response to direct electrical stimulation of the vestibular branch of the eighth pair of cranial nerves was investigated as a basis for more thorough study of vestibular-vascular impairments. A total of 53 neurons with background activity was recorded. Some of the neurons were characterized by stable uniform discharges, while others displayed a frequency modulation from one to ten spikes per second. On the basis of the experiments, the vasomotor neurons are classified into two groups using the criterion of vestibular nerve response to stimulation by individual impulses of equal intensity. The results indicate that only a small part of the vasomotor neurons can be innervated monosymptically by the primary vestibular afferent fibers, while the majority is activated through intermediate relays, including the trianguair nucleus and some cell groups in the vestibular nuclei. R.B.

N70-39221# Joint Publications Research Service, Washington, D.C.
CHANGE IN THE TOPOGRAPHY OF LIPID DISTRIBUTION IN THE SUPRARENAL CORTEX UNDER THE INFLUENCE OF 'NEGATIVE' ACCELERATIONS
V. V. Yazvikov et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 130–131 refs (See N70-39201 22-04)
Avail: NTIS

The histophysiology of the suprarenal cortex was investigated at different times after exposure to sublethal accelerations. White mice were subjected to an acceleration of 92 g on a laboratory centrifuge for one minute. The animals were placed in rotor recesses at an angle of 45 deg to the vector of centripetal acceleration and the radius of heat rotation was a maximum of 4.5 cm. The study shows that neutral fats in the suprarenal cortex are localized primarily in the fascicular zone of the control animals, with fewer fats in the glomerular zone, and virtually none in the reticular zone. Immediately after centrifuging the content of neutral fats in the glomerular and fasicular zones is considerably reduced, but increases in the reticular zone. During a period of 56 hours the fats are redistributed among different cortical zones. The redistribution of fats in the cortical zones indicates that the hormonal spectrum of the organ is not constant during this period and differs from the normal spectrum. Periodic normalization of fat localization may also indicate a cyclicity in the process. R.B.

N70-39222# Joint Publications Research Service, Washington, D.C.
VIABILITY OF CHLORELLA IRRADIATED BY 645 MeV PROTONS
I. S. Sakovich et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 132–135 refs (See N70-39201 22-04)
Avail: NTIS

The viability of Chlorella pyrenoidosa SP-K was investigated during irradiation and subsequent cultivation in the exponential growth segment of an asynchronous culture in a fluid Tamiya nutrient medium. The range of radiation doses was from 0.5 to 50 krad. After irradiation the increase in optical density of the culture was observed and the percentage of effectively surviving cells and the duration of the latent and transient period were determined. The values of the parameters are given in tabular form. R.B.

N70-39223# Joint Publications Research Service, Washington, D.C.
SWEET POTATO TOLERANCE TO IONIZING RADIATION
D. F. Gertsuskiy et al *In its* Space Biol. and Med., Vol. 4, no. 3, 1970 4 Sep. 1970 p 136–138 refs (See N70-39201 22-04)
Avail: NTIS

Young freshly cut grafts of sweet potato were irradiated with cobalt 60 gamma rays with doses of 0.5, 1, 2, 5, 8, 10, and 20 krad. The irradiated and control grafts were placed in containers with a nutrient solution for determining their capacity to take root. The rooted grafts and sprouts were set out in a specialized greenhouse and cultivated for 85 and 100 days by the hydroponics method on a Knopp's nutrient solution under illumination of ZN-8 mirror lamps. The results show that a dosage of more than 8 krad is lethal for the grafts and approximately 50% of the plants to 5 krad die. In the surviving plants the roots were poorly formed and the plants lagged considerably behind the controls in growth and development.
Author

N70-39248 California Univ., Berkeley.
ORGANIC GEOCHEMISTRY
William Van Hoeven, Jr. (Ph.D. Thesis) 1969 254 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.30 Order No. 69-18984

Organic geochemical research on the origin of life is discussed in a historical and scientific context. The concept of biological markers and chemical fossils are discussed in detail. Each of the four major classes of biochemicals, carbohydrates, proteins and peptides, nucleic acids, and lipids are analyzed as to the suitability, either of individual compounds or of conglomeration within a compound type, for use as chemical fossils. Structural specificity, biosynthetic relatability, possible abiotic synthesis, and thermal stability are discussed. Experimental results relevant to the origin of life problem are described. The alkane constituents of nine geological samples ranging in age from 2000 to 27 billion years were examined. Some pigments were identified in the two youngest sediments and fatty acids from the six oldest samples were also examined.
Dissert. Abstr.

N70-39269# Illinois Univ., Urbana. Dept. of Physics and Materials Research Lab.
DELAYED FLUORESCENCE AS A PROBE OF RADIATIONLESS TRANSITIONS IN ANTHRACENE AND ALGAE
William Turlay Stacy (Ph.D. Thesis) Jun. 1970 119 p refs
(Contracts AT(11-1)-1198; DA-ARO(D)-31-124-G-873; ARPA SD-131)
(COO-1198-722) Avail: NTIS

In the case of crystalline anthracene, the blue light-excited delayed fluorescence is used to study the temperature dependence of monomolecular intersystem crossing. The associated rate constant k is found to obey an equation of the form k = k sub 1 + k sub 2 exp(-E/k sub B T) where E = 1/900 + or - 100 cm and k sub 2/k sub 1 = 800 + - 200. A calculation of the relevant Franck-Condon factors using the method developed by Seibrand yields good agreement with the experimental value of k sub 2/k sub 1. At temperatures below 90 K, the temperature dependence of the delayed fluorescence intensity exhibits a pronounced maximum which is qualitatively explained in terms of triplet exciton traps. The delayed fluorescence emitted by algae is explained in terms of a triplet exciton fusion model in which the production of triplets is mediated by a photochemical reaction center. At low light levels, the delayed fluorescence intensity is proportional to the square of the excitation intensity. Author

N70-39312# Joint Publications Research Service, Washington, D.C.
DISCUSSION OF THE ORGANISM-ENVIRONMENT PROBLEM
V. A. Baraboy *In its* Cybernetic Systems and Biol. 28 Aug. 1970 p 13-23 refs (see N70-39310 22-05)
Avail: NTIS

The development of biology, in particular genetics, molecular biology, virology, radiobiology, ecology, space biology, biochemistry, and biophysics, disproves the theory of autogenesis and its opposite point of view. All living organisms are composed of the same material as the inorganic world. The basic difference which distinguishes living matter lies in its system of organization. As evoluation advances, there is intensification of both the quantitative and qualitative influence of life upon its environment, and also on the character of the links and the interaction of organisms with their environment. But the dependence of organisms upon the concrete conditons of existence diminishes with increase in their degree of organization. Consequently, organic evolution in its most general form can be regarded the process of gradual liberation of living systems from the domination of the environment. Author

N70-39313# Arizona Univ., Tucson. Coll. of Engineering.
PROCEEDINGS OF AIR POLLUTION CONTROL SEMINAR
13 Feb. 1970 166 p refs Conf. held at Tucson, Ariz., 13 Feb. 1970 *Its* EES Ser. No. 28
(Rept-60-70-28-600) Avail: NTIS

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1. TOWARD A CLEANER ENVIRONMENT J. E. Blough (GM Desert Proving Ground, Mesa, Ariz.) p 4-11 (See N70-39314 22-04)

2. THE FUTURE OF VEHICULAR POWER PLANTS E. S. Starkman (Calif. Univ., Berkeley) p 12-52 refs (See N70-39315 22-28)

3. AIR POLLUTION AND HEALTH B. Burrows p 53-76 (See N70-39316 22-04)

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6. WITH CURRENT TECHNOLOGY CAN COPPER SMELTERS MEET PROPOSED AIR QUALITY STANDARDS? J. E. Foard (Kennecott Copper Corp.) p 101-127 refs (See N70-39319 22-06)

7. AIR POLLUTION, URBAN GROWTH, AND ASTRONOMY G. W. Lockwood p 128-141 refs (See N70-39320 22-04)

8. ARE ARIZONA'S AIR POLLUTION CONTROL LAWS ADEQUATE? N. E. Schell (Ariz. State Dept. of Health) p 142-153 (See N70-39321 22-04)

9. TECHNOLOGICAL AND ECONOMIC LIMITS OF SMOKE CONTROL W. P. Goss (Magma Copper Co.) p 154-161 (See N70-39322 22-06)

N70-39314# General Motors Desert Proving Ground, Mesa, Ariz.
TOWARD A CLEANER ENVIRONMENT
John E. Blough *In* Ariz. Univ. Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 4-11 (See N70-39313 22-04)
Avail: NTIS

Progress is reported on efforts to eliminate the automobile as a cause of smog, with examples in the Los Angeles area. It is stated that emission controls on new cars are substantially reducing hydrocarbon output. Potential gains which may be realized from reductions in gasoline volatility, removal of tetraethyl lead from automobile gasoline, engine maintenance, and crankcase control devices are suggested. Research and development efforts to reduce carbon monoxide and nitrogen oxide emissions are mentioned. P.A.B.

N70-39316# Arizona Univ., Tucson. Coll. of Medicine.
AIR POLLUTION AND HEALTH
Benjamin Burrows *In its* Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 53-76 (See N70-39313 22-04)
Avail: NTIS

The chronic and acute effects of air pollution on health are discussed. It is stated that, although meaningful figures are unobtainable, there is no harmless level of air pollution; consequently, all pollution producers should be required to reduce their air contamination to the lowest possible level compatible with their operations. P.A.B.

N70-39320# Kitt Peak National Observatory, Tucson, Ariz.
AIR POLLUTION, URBAN GROWTH, AND ASTRONOMY
G. W. Lockwood *In* Ariz. Univ. Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 128-141 refs (See N70-39313 22-04)
Avail: NTIS

The effects of air pollution and city lights on ground based astronomy are investigated. A study of observing conditions at Kitt Peak National Observatory for the decade 1960 to 1969 is described, and median annual extinction coefficients for both UBV and uvby photometry systems are presented. The constributions of the copper industry to sulphur dioxide pollution and of transportation to carbon monoxide pollution are discussed with special regard to the failures of business, the public, and government to solve the problem. Author

N70-39321# Arizona State Dept. of Health, Phoenix. Air Pollution Control Div.
ARE ARIZONA'S AIR POLLUTION CONTROL LAWS ADEQUATE?
N. E. Schell *In* Ariz. Univ. Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 142-153 (See N70-39313 22-04)
Avail: NTIS

The provisions deemed necessary to the control of air pollution are outlined and used in evaluating the law in Arizona. Deficiencies in the current air pollution definition are discussed. Limited aspects of the present law are mentioned with regard to open burning restrictions, vehicle performance standards, agricultural exemptions, guidelines for emergency actions, penalties for misdemeanors, permits, and variance procedures. P.A.B.

N70-39329# Addis Translations International, Woodside, Calif.
CHROMOSOME ANOMALIES IN PERSONS WORKING UNDER CONDITIONS OF EXPOSURE TO IONIZING RADIATION
St. Zhivkov et al Jan. 1970 24 p refs Transl. into ENGLISH from Suvremenna Med. (Sofia), v. 19, no. 5, 1968 p 455–452 Prepared for Calif. Univ., Livermore. Lawrence Radiation Lab.
(UCRL-Trans-10442) Avail: NTIS

Structural and numerical chromosomal abnormalities were found in cultured leucocytes from 34% of the person tested who had worked for two years under conditions of exposure to ionizing radiation and had received a mean annual dose of 17 to 682 millirads. The results indicate that small doses of ionizing radiation can produce chromosomal changes in human somatic cells. Author (NSA)

N70-39339*# Translation Consultants, Ltd., Arlington, Va.
CERTAIN LAWS OF CHANGE IN BRAIN ALBUMINS DURING PHYLOGENY AND ONTOGENY [O NEKOTORYKH ZAKONOMERNOSTYAKH IZMENENIY BELKOV MOZGA V FILO- I ONTOGENEZE]
Z. D. Pigareva et al Washington NASA Sep. 1970 14 p refs Transl. into ENGLISH from the publ. 'Abiogenez i Nachalnyye Stadii Evolyutsii Zhizni' Moscow, Nauka Press, 1968 p 159–168
(Contract NASw-2038)
(NASA-TT-F-13193) Avail: NTIS CSCL 06C

Certain laws of change in brain albumins during phylogenic and ontogenic processes are discussed and properties of the albumins of specific cerebral structures are studied. Author

N70-39343# Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry.
THE ACTION OF RADIATIONS ON SOME BIOLOGICAL MODEL SYSTEMS Technical Progress Report, 1966–1969
Gabriel Stein 12 Sep. 1969 21 p refs
(Contract AT(30-1)-3242)
(NYO-3242-34) Avail: NTIS

Using an aqueous solution of sodium salicylate as the model system, a study was made of the theoretical treatment of light emission under ionizing radiation. Comparisons were made between fluorescence induced by ultraviolet radiation and that induced by ionizing radiation. An experimental and theoretical nuclear magnetic resonance study of the sodium salicylate aqueous system was undertaken to substantiate the assumption of dimerization. The effects of steady state X irradiation of light emission were investigated. Effects of ionizing radiation on excitation processes in organic systems were studied using isomerization of stilbene in solvents, such as benzene, as an indicator of excited state formation. Studies on the role of free radicals in the radiation chemistry of biochemical and biological model systems included a detailed investigation of the specific mechanisms involved in the action of hydrogen atoms. Other studies were conducted on effects of ionizing radiation on gel systems. NSA

N70-39416*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLANETARY QUARANTINE AND BACK CONTAMINATION
In its Res. and Advanced Develop. 31 Aug. 1970 p 211–238
(See N70-39411 22-34)
Avail: NTIS CSCL 06M

Developed are necessary information and procedures that will permit the successful application of cleaning and decontamination processes to space hardware. Success will be evaluated in terms of bactericidal and sporicidal activity and compatibility with typical spacecraft materials. Determined are the effects upon process efficiency of varying the process parameters: (1) temperature; (2) relative humidity; (3) ethylene oxide concentration; (4) pressure; (5) carrier gases; and (6) duration of prehumidification phase. The effects of gas flow volume and velocity during all phases of the cycle are being evaluated and tests are being carried out on inoculated test pieces that simulate flight hardware. Author

N70-39422*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FILM BOILING TRANSITION TEMPERATURE FOR TISSUE COOLED WITH LIQUID NITROGEN
Robert C. Hendricks [1970] 7 p refs Proposed for presentation at Winter Ann. Meeting of the ASME, New York, 20 Nov.-3 Dec. 1970
(NASA-TM-X-52878) Avail: NTIS CSCL 06E

A series of tests were undertaken to determine the film boiling transition temperature (T sub DFB) of in-vitro pigskin using liquid nitrogen as the coolant. No unique value was found; however for the horizontal minimum disturbance system T sub DFB $\times$ 243 K and for irregular surface topology T sub DFB ranged from 260 to 275 K. Lesions and surface particles were found to cause immediate transition followed by high cooling rates. Lesions for particles can be used for controlled cooling in varying geometric patterns. Contouring and surface masking using plastics and metals can also be used to control cooling rates. In-vivo experiments on fingers were in close agreement with the in-vitro tests on pigskin. No deep freezing was permitted. Author

N70-39460# Strangeways Research Lab., Cambridge (England).
THE STRANGEWAYS RESEARCH LABORATORY, 1968
1968 64 p refs
(NP-18090) Avail: AEC Depository Libraries

Research in radiobiology consisted of studies on the effects of antiserum on Chinese hamster fibroblasts, its influence on sensitivity of cells to X radiation, and changes in X-radiosensitivity of the developing rat eye. Other studies are reported on the cell surface of erythrocytes, lymphoid cells and macrophages, biochemistry of connective tissue, developmental biology and histology, reproductive physiology, pathology, and cancer. NSA

N70-39484# Joint Publications Research Service, Washington, D.C.
EFFECTS OF MICROWAVE IRRADIATION
25 Aug. 1970 10 p refs Transl. into ENGLISH from Gigena Truda i Prof. Zabolevaniya (Moscow), no. 7, 1970 p 24–27; 51–52
(JPRS-51238) Avail: NTIS

CONTENTS:

1. DEVELOPMENT AND CLINICAL COURSE OF CARDIOVASCULAR CHANGES AFTER CHRONIC EXPOSURE TO MICROWAVE IRRADIATION K. V. Glotova et al p 1–5 refs (See N70-39485 22-04)

2. CHANGE IN THYROID FUNCTION AFTER CHRONIC EXPOSURE TO MICROWAVE IRRADIATION N. A. Dyachenko p 6–8 refs (See N70-39486 22-04)

N70-39485# Joint Publications Research Service, Washington, D.C.
DEVELOPMENT AND CLINICAL COURSE OF CARDOVASCULAR CHANGES AFTER CHRONIC EXPOSURE TO MICROWAVE IRRADIATION
K. V. Glotova et al *In its* Effects of Microwave Irradiation 25 Aug. 1970 p 1–5 refs (See N70-39484 22-04)
Avail: NTIS

The nature, severity, and clinical course of cardivascular changes are described during low intensity microwave irradiation. Neurological changes, hypotension, and bradycardia were found to occur most often. Results of dynamic observations of patients are presented in tabular form. J.A.M.

N70-39486# Joint Publications Research Service, Washington, D.C.
CHANGE IN THYROID FUNCTION AFTER CHRONIC EXPOSURE TO MICROWAVE IRRADIATION
N. A. Dyachenko *In its* Effects of Microwave Irradiation 25 Aug.

1970 p 6–8 refs (See N70-39484 22-04)
Avail: NTIS

A thyroid study using I 131 was performed in humans systematically exposed to microwaves in the 1 cm range. Duration of exposure was 3.5 hours per week. The amount of absorbed I 131 was determined 2, 4, and 24 hours after ingestion using gamma ray intensity measurement near the isthmus; basal metabolism was also determined. Numerical studies showed that microwave radiation impairs the correlations of nervous processes and diencephalic regulation in organs and tissues. J.A.M.

N70-39518*# Translation Consultants, Ltd., Arlington, Va.
MATHEMATICAL METHODS FOR STUDYING CARDIAC AUTOMATISM AND THEIR APPLICATION TO SPACE MEDICINE [MATEMATICHESKIYE METODY OTSENKI SERDECHNOGO AVTOMATIZMA I IKH PRIMENENIYE V KOSMICHESKOY MEDITSINE]
O. G. Gazenko et al Washington NASA Sep. 1970 12 p refs Transl. into ENGLISH from the publ. "Problemy Vychislitelnoy Diagnostiki" Leningrad, Nauka Press, 1969 p 7–15
(Contract NASw-2038)
(NASA-TT-F-13218) Avail: NTIS CSCL 06P

Results show that the methods provide criteria which may be important in checking the condition of cosmonauts during space flights. The criteria can be used to work out algorithms for automatic medical control according to data from a small number of the most common methods used in obtaining physiological information during the flight. Author

N70-39547# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
RENAL HEMODYNAMIC RESPONSE OF UNANESTHETIZED DOGS TO POSITIVE ACCELERATION
John E. Chimoskey 29 Dec. 1969 39 p refs
(AD-708379; NADC-MR-6905) Avail: NTIS CSCL 6/19

Trained unanesthetized dogs were exposed to positive centrifugal accelerations up to +6Gz. Renal arterial pressure and inferior vena cava pressure at kidney level were measured through indwelling catheters. Renal blood flow velocity was measured by a Doppler principle ultrasonic flow meter. The flow signal was telemetered and the pressure signals were transferred by slip rings from the centrifuge. About 10 days after the sensing devices were implanted, under pentobarbital anesthesia, the experiments began for which the dogs were unanesthetized. The mean pre-acceleration mean renal arterial pressure, arterial-venous pressure gradient, and flow velocity were respectively 140 plus or minus 2 (S.E.) mm Hg, 133 plus or minus 2 mm Hg and 27 plus or minus .4 cm/sec. Renal flow velocity decreased in proportion to plus Gz to a minimum of 4.5 plus or minus .8 cm/sec during +6Gz. Mean renal arterial pressure rose at all G levels to 160-170 mm Hg. The pressure gradient was stable up to +3Gz, and decreased at +4, 5, and 6Gz to 76 plus or minus 7 mm Hg during 06Gz. Intrarenal phenoxybenzamine, 150 micro gm/min x 30 min, which did not alter pre-acceleration renal arterial pressure and blood flow velocity, partially inhibited the flow velocity reduction during +Gz. Intrarenal vasoconstriction mediated by alpha adrenergic receptors is part of the response to +Gz. Author (TAB)

N70-39661# Washington State Univ., Pullman.
BEHAVIORAL ASSESSMENT OF VISUAL FUNCTIONING IMMEDIATELY AFTER EXPOSURE OF THE EYE TO A LASER
Ernest S. Graham (ARL), Donald N. Farrer (ARL), Roger G. Mark (AFWL), and Thomas A. Fields Holloman AFB, N. Mex. ARL May 1970 21 p refs
(Contract F29600-69-C-0007)
(AD-707871; ARL-TR-70-9) Avail: NTIS CSCL 6/19

A behavorial program is described which permits assessment of visual functioning in rhesus monkeys immediately following laser- induced foveal impairment. Six rhesus monkeys were trained on a visual discrimination problem involving Landolt rings. Subjects received stimuli via viewing tubes to either the right or left eye on a random basis. An equal number of stimuli were presented to each eye. Midway through the behavioral program the right eye was exposed to a neodymium laser. Post-exposure behavioral testing began immediately thereafter. The behavioral data predicted the occurrence of foveal impairment as verified by fundus photographs taken approximately 1 hour after exposure. Author (TAB)

N70-39672# California Univ., La Jolla.
A CONTINUED STUDY OF THE DEEP CIRCULATION AND DEEP FISH POPULATIONS IN THE PACIFIC OCEAN
John D. Isaacs and Richard A. Schwartzlose 4 May 1970 18 p refs
(Contract AT(11-1)-34)
(UCSD-34-P-127-7) Avail: NTIS

Deep photographs and current measurements were taken to contribute to the understanding of the deep near-bottom ocean environment. Previously the abyssal bottom and near bottom were thought to be nearly devoid of fish life and the steady currents to be only to a few mm/sec at the absolute maximum. The photographs have shown active abyssal life to be most plentiful, even at abyssal depths, and the steady currents to be several cm/sec, with tidal and transient currents much higher. A few motion pictures down to 1000 m were made with a newly-developed camera. These photographs show that the most abundant fish to 1000 meters off California and Baja California are the hag fish. The current measurements and the deep fish studies are becoming vital in discussions concerning disposal and pollution near the bottom on the continental shelf and at abyssal depths (for example, war gases), and have been employed by other investigators in examination of potential new fisheries. Author (NSA)

N70-39676# Michigan State Univ., East Lansing. Computer Inst. for Social Science Research.
A RANDOM-WALK MODEL FOR UELATIVE CONFLICT
E. Alan Hartman and James L. Phillips 15 Jun. 1970 63 p refs
(Contract F44620-69-C-0114)
(AD-707880; AFOSR-70-1001TR; Rept-69-2) Avail: NTIS CSCL 5/10

A single parameter model was proposed to account for the interpersonal process in a triadic conflict situation. The parameter is the estimated probability of a player attacking the stronger of his two attack choices. The model was tested on data that had been collected previously. The points of bad fit were pinpointed and an explanation given. Changes in the experimental procedure were proposed and a more complete test of the model was outlined. Author (TAB)

N70-39689# Technische Hochschule Darmstadt (West Germany).
CONCERNING THE PERCEPTION OF VARIOUS LIGHT FLASHES WITH VARYING SURROUNDINGS LUMINANCES
Hans Joachim Schmidt Clausen (Ph.D. Thesis) 1970 182 p refs
(PB-191361) Avail: NTIS CSCL 06O

The problem dealt with in the present work is that of determining the effective luminance of a flashing light in relation to a constantly burning signal light. The influence of the following factors is investigaged: signal color, viewing angle, surroundings-adaptation luminance, pulse shape, and exposure time. The criterion chosen for study was the achromatic and chromatic threshold luminance. Author (USGRDR)

N70-39777# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
PROSTAGLANDIN INDUCE, STRESS RELATED,

PHOSPHOLIPID CHANGES IN THE RAT

B. David Polis, R. Paul Miller, Anna Marie Pakoskey, H. P. Schwarz, and Edith Polis 10 Jun. 1970 32 p refs

(AD-708381; NADC-MR-7006) Avail: NTIS CSCL 6/19

The injection of the prostaglandin isomers (PGE1, PGF1-alpha, PGB1, and PGBx) into rats caused changes in plasma and brain phosphatidyl glycerol and related phospholipids that mimic the changes found in accelerated rats and in the plasma of physically or psychially stressed humans. The prostaglandin effects on normal rat plasma phospholipids were abolished in the hyprophysectomized rat. A similar block in phospholipid change was observed in hypophysectomized rats subjected to acceleration stress. All four prostaglandin isomers caused significant increases in plasma and brain phosphatidyl glycerol. Differences were observed in the effects on other phospholipids. Thus PGE1 decreased the total plasma phospholipid and phosphatidyl choline levels while PGF1-alpha increased both levels. PGE1 caused severe symptoms of lassitude and diarrhea in both normal and hypophysectomized rats. These effects were absent with the other prostaglandin isomers. In contrast, PGBx appeared to enhance the state of well being and lively behavior of the rat. These results, in conjunction with previous work on phospholipids in stress, implicate the prostaglandins in an adaptive response to stress which involves the mobilization of energy yielding molecular components and a gearing of metabolic events for survival. Author (TAB)

N70-39804# Central Research Inst. for Physics, Budapest (Hungary).

INVESTIGATION OF Zr-T AEROSOL

I. Feher and J. Biro 1970 12 p refs

(KFKI-70-9) Avail: AEC Depository Libraries

The tritium incorporation hazard presented by detached solid particles for zirconium-tritium targets for production of 14-MeV neutrons was studied. The aerosol parameters of the particles detached from the zirconium-tritium targets were studied and the inhalation hazard was evaluated from personnel and area contamination monitoring data. NSA

N70-39850*# National Aeronautics and Space Administration, Washington, D.C.

VARIATIONS OF THE ACCELERATIVE FIELD IN SOME COMMON AMUSEMENTS [VARIAZIONI DEL CAMPO ACCELERATIVO IN ALCUNI SVAGHI COMUNI]

A. Scano Oct. 1970 6 p Transl. into ENGLISH from Riv. Med. Aeron. Speziale (Rome), v. 33, no. 1, Jan.–Feb. 1970 p 133–138

(NASA-TT-F-13343) Avail: NTIS CSCL 06S

The + or – Gz accelerations connected with the motion of vehicles characteristic of amusement parks, switchbacks, and cabins of the various revolving and oscillating attractions were registered with a one component accelerograph. The tracings showed extreme values of from + 0.1 to + 3.2 Gz of a duration not exceeding one second, with variations of up to more than 60 G/sec, alternating with different positive G periods of 2 to 3 seconds each. In the rotors, great cylinders on a vertical axis rotating at 40 revolutions per minute, an approximate + 4 Gx is reached. The rarity of motion sickness in the described conditions is discussed. Author

N70-39867# Howard Univ., Washington, D.C. Dept. of Physiology.

EFFECTS OF ALTITUDE ON CELLULAR METABOLISM AND TERMINAL OXIDATION Annual Report, 15 Apr. 1969–14 Apr. 1970

Leslie C. Costello and Armand J. Gold May 1970 14 p

(Contract DAHC19-68-G-0020)

(AD-707985; Rept-2) Avail: NTIS CSCL 6/19

The report presents continuation studies of the effects of altitude exposure on energy metabolism and mitochondrial activity in rats. Exposure of rats in experimental chambers at a simulated altitude of 25000 ft. resulted in a consistent elevated plasma pyruvate. The animals under these conditions developed hypophagia, weight loss, and increased hematocrits. Isolated liver and kidney mitochondria from these animals did not exhibit any alterations in cytochrone oxidase activity, respiratory control ratio, or ADP/O ratio. However state 4 respiration of kidney mitochondria was significantly and consistently decreased in altitude animals. Author (TAB)

N70-39917# Naval Air Development Center, Johnsville, Pa.

A CARDIOVASCULAR DYNAMIC RESPONSE INDEX

Richard J. Crosbie, Carl T. Reichwein, and Emma Fessenden 26 Jun. 1970 17 p refs

(AD-708383; NADC-MR-7010) Avail: NTIS CSCL 6/19

Human tolerances to accelerating forces long have been recognized as being dependent on the magnitude, direction, and duration of a given G. Experimentally derived tolerance curves for positive G have been reported by Stoll and Kydd. The former provides the time (time at peak pulse rise time) at which a given end-point (PLL) will occur for various sustained G levels while the latter provides the period of haversine shaped G profile which will produce the same end-point for various peak Gs. Aerodynamically derived G profiles take on a wide variety of shapes and forms. Using a lumped parameter description for both the arterial and venous portions of the cardiovascular system, a simplified mathematical model has been derived which includes a feedback loop for changes in cardiac output and peripheral vascular resistance to represent the non-linear effects of cardiovascular reflexes. The model, which describes the transient and steady state response of the system to any shaped G profile, has been programmed on an analog computer. By identifying a particular response of the system to correspond with a given endpoint (PLL), a cardiovascular dynamic response index (CDRI) HAS BEEN DEFINED5 By using the CDRI, the model provides agreement with both the Stoll and Kydd tolerance curves. Author (TAB)

N70-39921# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

CORONARY BLOOD FLOW AND ELECTROCARDIOGRAM DURING HEADWARD ACCELERATION IN UNANESTHETIZED DOGS

John E. Chimosley 9 Jun. 1970 15 p refs

(AD-708380; NADC-MR-7005; Rept-15) Avail: NTIS CSCL 6/19

Trained unanesthetized dogs were exposed to brief, 10-second, positive acceleration on the 8-foot animal centrifuge at the Naval Air Development Center, Warminster, Pa. Both the amplitude of the T-wave of the left ventricular surface electrocardiogram and left circumflex coronary artery blood flow velocity decreased during headward acceleration. Post acceleration hyperemia occurred as T-wave amplitude returned to normal. Author (TAB)

N70-39948# Washington Univ., Seattle.

MULTIPLE PREDICTION STUDIES Final Report, May 1953–Feb. 1970

Paul Horst Jun. 1970 18 p refs

(Contracts Nonr-477(08); Nonr-477(33))

(AD-708059) Avail: NTIS CSCL 5/10

The report indicates the general areas of investigation in a program of research in the prediction of personal adjustment, conducted over a period of seventeen years. The publications resulting from the research and listed in the bibliography include thirty-six (36) theses, forty-seven (47) technical reports, twenty-six (26) journal articles, eight (8) monographs, four (4) chapters in books, and four (4) books. Author (TAB)

N70-40091# Oak Ridge National Lab., Tenn.
THE CALCULATION OF NEUTRON-INDUCED PHYSICAL DOSES IN HUMAN TISSUES
J. J. Ritts (M.S. Thesis), M. Solomito (M.S. Thesis), and P. N. Stevens (M.S. Thesis) 22 May 1970 108 p refs Sponsored in part by AEC and DASA
(AD-707742; ORNL-TM-2991) Avail: NTIS CSCL 6/18

The purpose of the investigation was to calculate improved multicollision neutron fluence-to-dose conversion factors by solving the combined neutron and gamma-ray transport problems in phantom models designed to represent human beings. Also, new neutron fluence-to-kerma factors and improved secondary gamma-ray yields were to be determined for the elements composing the slabs. The computer code ANISN was employed in solution of the transport equation. Multicollision neutron fluence-to-dose conversion factors were calculated for neutron sources, either beams or isotropic fluxes of energies from 15 MeV to thermal incident on a 30 cm slab with infinite or finite transverse dimensions. The curves representing the total of the neutron and gamma-ray energy deposition were found to range from approximately 6% to a factor of two lower than those previously reported. This effect is attributed primarily to the treatment of secondary gamma rays and becomes more pronounced with increasing depth. Results are presented for 38 different combinations of source and geometry and for the maximums as a function of the source energy for each set of calculations. Author (TAB)

N70-40098# Naval Submarine Medical Center, Groton, Conn. Medical Research Lab.
DECREASE IN PERCEIVED DISTORTION WITH REPEATED EXPOSURE: APPLICATION FOR NAVAL DIVER TRAINING Interim Report
Christine L. McKay 16 Feb. 1970 12 p refs
(AD-708026; SMRL-613) Avail: NTIS CSCL 6/19

With repeated exposure to a distorted visual environment an individual perceives less distortion on each subsequent occasion. This positive advantage of repeated exposure is found to transfer to a different distortion provided that the subject has not had too much experience with the first distortion. Overtraining on one distortion cancels any positive transfer of advantage from one distortion to another. It may, therefore, be possible to train divers, out of water, to perform more effectively as soon as they enter the water. Author (TAB)

N70-40100# Naval Submarine Medical Center, Groton, Conn. Medical Research Lab.
THE EFFECT OF INTERMITTENT EXPOSURE TO 3% CO2 ON RESPIRATION Interim Report
K. E. Schaefer, C. R. Carey, and J. H. Dougherty, Jr. 13 Mar. 1970 14 p refs
(AD-708030; SMRL-618) Avail: NTIS CSCL 6/19

One healthy male subject was exposed for six days, 15 hours daily, to a CO2 concentration rising from 0 - 3% CO2 at normal oxygen concentrations of 20 - 21% O2. Average data of physiological measurements made (A) prior ot and (B) at the end of the 15-hour exposure to CO2 concentration, rising linearly from 0 - 3% CO2 were pACO2(A): 40.7 mm Hg; pACO2(B): 42 mm Hg; pAO2(A): 100.7 mm Hg; pAO2(B): 114.8 mm Hg; VE(A): 6.28 L/m; VE(B): 12.09 L/m. pACO2 determined at the end of the none-hour air breathing rose from the third day on to reach, at the fifth day, a peak higher than the corresponding value following 15 hours of CO2 inhalation. During the sixth day of intermittent exposure to CO2, pAO2 on air returned to control values. This finding indicates that after three days the nine-hour period of air breathing was insufficient to eliminate the CO2 accumulated during the 15-hour period of CO2 breathing. Ventilatory response to 5% CO2 was increased during intermittent exposure to CO2 and the slope of the CO2 tolerance curve was also increased. Author (TAB)

N70-40134*# National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography with Indexes
Aug. 1970 111 p refs
(NASA-SP-7011(79)) Avail: NTIS CSCL 06E

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N70-40150# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
RESEARCH ON DEEP SUBMERGENCE DIVING PHYSIOLOGY AND DECOMPRESSION TECHNOLOGY UTILIZING SWINE, EVALUATION OF SWINE AS A HYPERBARIC ANALOG TO MAN AND DETECTION OF EMBOLI BY USE OF THE ULTRASONIC DOPPLER FLOWMETER Technical Progress Report, 15 May 1969--15 May 1970
Murlin F. Gillis 6 Jul. 1970 25 p refs
(Contract N00014-69-C-0350)
(AD-708748) Avail: NTIS CSCL 6/19

Sixteen miniature swine of similar size performed 83 dry chamber air dives, using no-stage profiles with linear ascent and descent rates of 60 ft/min, depths of 60 to 180 ft, and bottom times up to 120 min. Surface intervals always exceed 48 hr. Signs considered diagnostic of bends were lameness, persisting for 15 minutes or more and relieved by recompression, and/or acute, progressive respiratory distress, and/or central neurologic signs, e.g. paralysis. Bends was not observed at 60 ft with bottom times up to 120 min; a 60% incidence was recorded for 140 ft/60 min and a 16% incidence for 180 ft/20 min. Doppler flowmeter studies have shown that individual glass microballoons of 80-150 micra diameter are easily detectable in the thoracic caudal vena cava, and that 40 micra balloons, while difficult to detect individually, are easily detected when injected in large quantities. Severe caval air embolism has been recorded following 180 ft/15 min excursions without bends signs, confirming that significant gas embolism can exist in the absence of such signs and showing the value of the Doppler flow meter for embolism detection. Author (TAB)

N70-40182# Oregon Univ., Portland. Dept. of Biochemistry.
HYPEROSMOLARITY AND ASYMMETRIC SOLUTE MOVEMENT Progress Report, 1 Sep. 1969--31 Aug. 1970
John T. Van Bruggen [1970] 12 p
(Contract AT(45-1)-1754)
(RLO-1754-20) Avail: NTIS

Progress made in elucidating various aspects of the phenomenon known as solute drag are reported. A model of double solute or cross traffic interaction is described, along with tests of the system with several membranes and a variety of solutes. The experiments appear to demonstrate that solute interaction is not a unidirectional phenomenon but is the result of the imposition and/or addition of all the physical forces operative in the system. The production of a homopore membrane, with some 10 to the minus 7th or minus 8th power holes cm to the minus 2nd power, is discussed. The hole size is measured to be approximately 300 or 350 A. Experiments with the membrane in solute interaction situations indicate that on a homoporous membrane solutes interact, and/or the process of solute drag is present, just as it was on the heteroporous membrane. P.A.B.

N70-40218# Federation of American Societies for Experimental Biology, Bethesda, Md.
EFFECT OF LIGHT CONDITIONS ON THE ANTARCTIC CONTINENT ON AUTOREGULATION IN THE HUMAN BRAIN
P. V. Bundzen [1969] 6 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (USSR), v. 55, no. 8, 1969 p 929
(PB-189241T; NS-264) Avail: NTIS CSCL 06P

Assessed is the state of autoregulation of the brain during the South Polar night and South Polar day, constituting unaccustomed diurnal and seasonal photoperiodic conditions for inhabitants of the temperate latitudes of the USSR. It is noted that disturbances of the diurnal photoperiodicity during the polar night are combined with a marked decrease in the total intensity of illumination, which is on the average 250 times below that in the period of the polar day. Author (USGRDR)

N70-40281# Denver Univ., Colo. Dept. of Psychology.
TASK DIFFICULTY AND CHANNEL REDUNDANCY IN BISENSORY INFORMATION PROCESSING
Joseph Halpern Jul. 1970 27 p refs
(Contracts N00014-68-C-0383; N00014-67-A-0394-0001)
(AD-708675; TR-5) Avail: NTIS CSCL 6/16

Subjects were provided with either visual, auditory, or combined visual and auditory (bisensory) information. The stimuli were generated from recordings of ambient sea noises. The results showed the relation for recognition performance of the bisensory mode to either unisensory mode. Methodological factors such as task difficulty, channel redundancy, etc. were discussed as being relevant for the study of bisensory information processes. Author (TAB)

N70-40278# Denver Univ., Colo. Dept. of Psychology.
THE EFFECTS OF MOVEMENT-INDUCED NOISE AND CUES ON PERCEPTION
Joseph Halpern Jun. 1970 27 p refs
(Contract N00014-67-A-0394-0001)
(AD-708674; TR-4) Avail: NTIS CSCL 6/16

The experiment was designed to determine whether recognition performance would be improved or retarded with the use of non-static visual stimuli as opposed to static images. The stimulus objects were rocket-like projectiles, animated by an analog-digital computer. The stimuli varied across several dimensions of similarity and Ss task was to recognize the stimulus object which was presented for 1.5 sec. periods. The stimulus presentations differed as a function of speed of motion where motion was varied across two dimensions (horizontal and vertical). The Ss were paid a bonus for correct responses with the bonus decreasing as a function of the time it took to make the decision. The prime dependent measure was choice reaction time. The present results, which should be considered preliminary, suggested that performance could be improved by motion. That is, motion might possibly provide an advantageous ratio between information and interference. Author (TAB)

N70-40283# RAND Corp., Santa Monica, Calif.
A DIRECT MECHANISM FOR THE INFLUENCE OF MICROWAVE RADIATION ON NEUROELECTRIC POTENTIALS
R. J. MacGregor Jun. 1970 30 p refs
(AD-706815; P-4398) Avail: NTIS CSCL 6/16

The paper explores the idea that the electrical component of applied microwave radiation might induce transmembrane potentials in nerve cells and thereby disturb nervous function and behavior. The paper estimates the transmembrane currents and potentials induced in nerve cells by applied electrical fields and currents. Estimates are made for steady and for oscillating stimulation. The primary conclusion is that intracranial electrical fields associated with low intensity microwave irradiation may induce transmembrane potentials of tenths of millivolts (or more) and that, therefore, such externally applied fields may disturb normal nervous function through this mechanism. The paper also presents an analysis which indicates that the induced transmembrane potential should exhibit a maximum in the microwave range of electromagnetic radiation. Author (TAB)

N70-40306*# Sandia Corp., Albuquerque, N.Mex. Planetary Quarantine Dept.
PLANETARY QUARANTINE PROGRAM Quarterly Progress Report, Period Ending 31 Dec. 1969
Dec. 1969 44 p refs
(NASA Order W-12853)
(NASA-CR-113668; QR-15) Avail: NTIS CSCL 06M

Techniques for planetary quarantine and bacterial spore inactivation are discussed. Subjects presented are: (1) bacterial spore inactivation modeling, (2) thermoradiation sterilization, (3) bioburden experimentation, and (4) computerized identification scheme. Author

N70-40307*# Minnesota Univ., Minneapolis. School of Public Health.
ENVIRONMENTAL MICROBIOLOGY AS RELATED TO PLANETARY QUARANTINE Semiannual Progress Report, 1 Dec. 1968–31 May 1969
Jun. 1969 53 p refs
(Grant NGL-24-005-160)
(NASA-CR-113669; SAPR-2) Avail: NTIS CSCL 06M

Environmental microbiology as related to planetary quarantine is discussed. Subjects presented are: (1) survival of bacillus spores at temperatures below 60 degrees C, (2) survival of bacillus spores in a controlled air stream, (3) effect of humidity, location, surface finish, and separator thickness on heat destruction of bacillus spores, and (5) detection of low levels of microbial contamination on surfaces by chemical approaches. Author

N70-40316# IIT Research Inst., Chicago, Ill.
OXYGEN TOLERANCE IN ATMOSPHERES SIMULATING UNDERSEA SATURATION DIVES Final Report, 1 Apr. 1967–30 Jun. 1970
James Q. Kissane and Willis H. Riesen 26 Jun. 1970 34 p refs
(Contract N00014-67-C-0395)
(AD-707754; IITRI-L6042-12) Avail: NTIS CSCL 6/19

Studies were conducted to determine the effects of a simulated Sealab environment on selected metabolic systems in rats. The simulated Sealab environment consisted of 98.2% helium and 1.8% oxygen atmosphere maintained at 300 psi at 22C. After 24 hr exposure and rapid decompression the following observations were made. Liver and muscle mitochondrial P:O and QO2 were normally functional. Liver LDH activity was slightly decreased. Muscle and liver glycolysis rates were unaffected. Protein synthesis in liver subcellular components measured by 14C-lysine uptake was unaffected while it decreased in muscle. Liver glycogen reserves decreased 8 to 10 fold, while muscle glycogen decreased approximately 50%. Control experiments in helium atmosphere at ambient pressure and those conducted at submergence pressure at elevated temperature suggested that thermal effects of helium resulted in increased glycogen utilization. To enable rapid sampling and freezing of tissue at pressure for nucleotide analyses, two biopsy devices were developed and evaluated. The Biopsy Probe, a boring device, was found not to be satisfactory when its performance was measured in terms of liver tissue ATP values. Using the same parameter the Surgical Biopsy Device provided rapid tissue excision and freezing by cryogenic immersion. Author (TAB)

N70-40358# Oak Ridge National Lab., Tenn.
SUMMARIES FROM ORNL-4559. THE MOLECULAR ANATOMY PROGRAM (THE MAN PROGRAM) Semiannual

Progress Report, 1 Sep. 1969 – 28 Feb. 1970
Apr. 1970 128 p refs
(Contract W-7405-eng-26)
(ORNL-4558; SAPR-2) Avail: NTIS

Tumor transplantation, Gallium-67 localization in tumor tissues, and isolation of hamster tumor cell plasma membranes are discussed as well as the surface morphology of normal and leukemic human lymphocytes. Analysis of body fluids, the chemistry of alpha-crystallin, protein sequence studies, and analysis of derivatives from sequential degradation are reported along with the molecular structure of the nucleus. GeMSAEC development and CIRCI are covered and cracking in anodized Teflon-filled coatings is mentioned. Applications of scanning electron microscopes, gel electrophoresis, chromatography, centrifugal chromatography, analytical centrifugation, microscopes, and sedimentation counting of viruses are outlined. Melanogenesis, isolation of single-stranded DNA in zonal rotors and the molecular size of mammalian DNA are also cited along with other aspects of the molecular anatomy program. J.M.

N70-40391# Hebrew Univ., Jerusalem (Israel). Dept. of Botany
A COMPUTER SIMULATION OF NATURAL PATTERN GENERATION PROCESSES Final Scientific Report, 30 Jun. 1967 – 31 Oct. 1969
Dan Cohen 30 Nov. 1969 48 p refs
(Grant AF-EOAR-45-67)
(AD-704132; AFOSR-70-0938TR) Avail: NTIS CSCL 6/4

Models of some natural pattern generating processes have been tested by computer simulation. The following models have been simulated with some degree of success. The generation of the pattern of the boundary of a growing mass of cells. Smooth or lobed patterns have been generated by purely local interactions between the cells at the boundary. The generation of drainage patterns on initially smooth surfaces. The only assumption in the model is that the rate of soil erosion is the product of some power of the local water velocity and an erodobility factor which varies randomly. The simulation could reproduce fairly well river competition and capture, and the effects of the slope and the soil heterogeneity on the drainage pattern, which occur naturally. The growth and development of the patterns as effected by mutual shading. There are positive feedback relations between the growth rates of adjacent branches and plants when the rate of elongation increases monotonically with light intensity. This causes a dominance of lighted branches over shaded branches. When the rate of elongation decreases as a function of light intensity over some range, the growth rates of adjacent branches tend to be the same, and they form a smooth level boundary. Author (TAB)

N70-40393# Naval Postgraduate School, Monterey, Calif.
DYNAMIC DEPTH PERCEPTION
Lawrence Arlan Rolstad (M.S. Thesis) Apr. 1970 49 p refs
(AD-709086) Avail: NTIS CSCL 5/10

A review of research in visual acuity and depth perception of moving objects disclosed differing estimates of the relation between dynamic and static vision performance. Additionally, two distinct types of responses appear in distance estimates for moving targets as well as the elapsed time estimates for partially concealed targets. The possible relation of this depth estimation error dichotomy to lateral phoria is discussed. An experiment demonstrates that the depth estimation error dichotomy, if it exists, is not related to phoria and is independent of the direction of target motion. Further evidence of the lack of correlation between dynamic and static depth perception is presented. Author (TAB)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N70-39159# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
QUANTITATIVE SAFETY ANALYSIS
J. W. Croach and L. M. Arnett Apr. 1970 52 p
(Contract AT(07-2)-1)
(DP-1207) Avail: NTIS

An analytical method is developed to assess the safety of an operation or a mission. A computer program, Probabilistic Analysis of Risk (PAR), is written to implement the quantitative features of this method. The analysis can incorporate judgment factors and can assess the results of accepting each of several alternatives. Author

N70-39202# Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF WATER EXCHANGE IN A BIOLOGICAL LIFE SUPPORT SYSTEM BASED ON ALGOBACTERIAL CULTURE
I. I. Gitelzon et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 1–9 refs (See N70-39201 22-04)
Avail: NTIS

Experimental data on water exchange in a biological life support system involving man and Chlorella with the concomitant microflora are discussed. Water sources within the system which can be used to satisfy human needs are evaluated. The described technological scheme of water exchange in the man-algobacterial culture system was used in long-term experiments in which the atmosphere and water were regenerated. The water recovery parameters made possible an evaluation of water recovery and methods for its improvement in a biological life support system. Author

N70-39203# Joint Publications Research Service, Washington, D.C.
USE OF HYPEROXIC AND HYPERCAPNIC GAS MIXTURES FOR INCREASING ORTHOSTATIC STABILITY
V. I. Korolkov et al *In its* Space Biol. and Med. Vol. 4, No. 3, 1970 4 Sep. 1970 p 10–17 refs (See N70-39201 22-04)
Avail: NTIS

It was found that the breathing of gas mixtures containing high concentrations of oxygen and carbon dioxide has a favorable effect on tolerance to 15-minute tilt tests. Orthostatic stability declined in response to hypovolemia due to artificial blood loss amounting to 0.8 percent body weight. No collaptoid state developed when the animals were breathing gas mixtures containing 5% CO2, 93% O2 and 2% N2 under hypovolemic conditions. Author

N70-39211# Joint Publications Research Service, Washington, D.C.
THE MEDICAL MONITORING SYSTEM ABOARD SOYUZ SPACESHIPS
Yu. G. Nefedov et al *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 70–78 refs (See N70-39201 22-04)
Avail: NTIS

The general principles applied in designing the medical monitoring system for the Soyuz-3, Soyuz-4 and Soyuz-5 spacecraft are presented. The physiological parameters monitored and the information sources used are described. The structural diagram of the medical instrumentation and biosensors is described. The principles of instrument design, storage, processing, and analysis of physiological data are discussed. The layout of the medical monitoring equipment is described, the system of biosensors is illustrated and examples of telemetric registry of physiological parameters are given. Author

N70-39217# Joint Publications Research Service, Washington, D.C.
SEARCHLESS ULTRASONIC DOPPLER CARDIOGRAPHY
V. G. Voloshin et al *In its* Space Biol. and Med., Vol. 4, No. 3,

1970 4 Sep. 1970 p 111–113 refs (See N70-39201 22-40)
Avail: NTIS

A method of searchless ultrasonic Doppler cardiography (UZDK) is discussed which makes it possible to determine the phases of the cardiac cycle from a curve recorded from the precardiac region using a fixed pickup without any special search for the valves. A transistorized variant of a Doppler 'cardioradar' was fabricated for the experiment. The studies revealed the characteristic changes in amplitude, frequency, and form of the UZDK specific for each phase, both systolic and diastolic. The complete identity of the phase structure was demonstrated by the searchless UZDK and other methods. R.B.

N70-39218# Joint Publications Research Service, Washington, D.C.
ADMISSABLE ERROR IN MEASURING THE BASIC PARAMETERS OF HUMAN MASS EXCHANGE
Yu. I. Aganin *In its* Space Biol. and Med., Vol. 4, No. 3, 1970 4 Sep. 1970 p 114–119 refs (See N70-39201 22-04)
Avail: NTIS

The mean normal daily consumption determining the nominal capacities of tanks designed for the storage of supplies and wastes and the output of regeneration equipment is discussed with respect to life support systems for a spacecraft crew. Two examples of evaluating the error in measurement of human mass exchange are given: using the criterion of minimum cost of a ground experiment and the criterion of minimum weight of the life support system. R.B.

N70-39270# Joint Publications Research Service, Washington, D.C.
HEURISTIC SELF-ORGANIZATION OF CYBERNETIC SYSTEMS
O. G. Ivankhnenko 2 Sep. 1970 22 p refs Transl. into ENGLISH from Visnyk Akad. Nauk. Ukr. RSR (Kiev), no. 7, 1970 p 23-27 (JPRS-51301) Avail: NTIS

Heuristic self-organization is discussed as the principle direction in the development of technical cybernetics. The different terms used in cybernetics are defined and specific and general approaches to the discipline are discussed. The perceptron, a model of functions of perception and recognition of the brain, is suggested as the optimal approach to which the mathematical single-row theory of statistical solutions must be expanded to a multi-row theory. R.B.

N70-39280*# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
TOXICOLOGICAL SCREENING OF SPACE CABIN MATERIALS
Gerd A. Kleineberg and Anthony A. Thomas *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 31–38 refs (See N70-39276 22-30)
(AMRL-TR-69-53) Avail: SOD $1.50; NTIS CSCL 05E

The effects of long-term continuous exposure to low concentrations of environmental contaminant are studied. To control toxic contaminants in space cabins and to identify individual gas-off stringent material selection and analytical gas-off studies are performed. Since 1965, 287 materials have analyzed prior to toxicological evaluation. Criteria for the screening process and methods for detailed gas-off studies are described. The effects of reduced atmospheric pressure and oxygen-rich atmospheres on the characteristics of truly uninterrupted long-term exposure to toxic trace contaminants are also studied. A brief description of the altitude inhalation exposure facility is given. Toxicological screening is perfc.med by continuously exposing rats and mice to the gas-off products of candidate materials within a closed-loop life-support system which in turn is located inside a Thomas dome. Two hundred ninety materials were screened for 7-day acute toxicity, and materials were studied for a 60-day duration. Results of the toxicological evaluations are discussed. Author

N70-39281*# Army Natick Labs., Mass.
FEEDING MAN IN SPACE
H. A. Hollender and Mary V. Klicka *In* NASA, Washington Proc. of the 7th Ann. Working group on extraterrest. Resources 1970 p 39–49 refs Sponsored in part by Air Force (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 06H

The development of space flight foods is reviewed and the types of food for different flights are described. The developmental problems such as crumbling, coating, and water impurities are discussed. The five categories of food used are sterile semi-solid foods, bite-size dehydrated foods to be eaten dry, precooked dehydrated foods to be reconstituted with water (rehydratable), thermally stabilized flexibly packaged wet foods, and intermediate moisture foods. N.E.N.

N70-39310# Joint Publications Research Service, Washington, D.C.
CYBERNETIC SYSTEMS AND BIOLOGY
28 Aug. 1970 25 p refs Transl. into ENGLISH from Filosofska Dumka (Kiev), no. 3, 1970 p 30–38 60–67
(JPRS-51270) Avail: NTIS

CONTENTS:

1. CLASSIFICATION OF CYBERNETIC SYSTEMS DISCUSSED O. A. Bratko et al p 1–12 refs (See N70-39311 22-50)

2. DISCUSSION OF THE ORGANISM-ENVIRONMENT PROBLEM V. A. Baraboy p 13–23 refs (See N70-39312 22-04)

N70-39311# Joint Publications Research Service, Washington, D.C.
CLASSIFICATION OF CYBERNETIC SYSTEMS DISCUSSED
O. A. Bratko et al *In its* Cybernetic Systems and Biol. 28 Aug. 1970 p 1–12 refs (See N70-39310 22-05)
Avail: NTIS

Depending on the conception of the theory of reflection, a definition of an adequate criterion of the level of a cybernetic system is suggested. Further, proceeding on this reflection theory, and regarding reflection as the central direction of the perfection of systems, the main element upon which a single-valued classification of systems can be based is delineated. Along with the element and with a classification criterion for systems, the mechanism of reflection of the systems is acknowledged. This mechanism can be defined as a material substrate whose structure determines the constantly repeating sequence of reactions of certain influences external to the given substrate. The fact that this mechanism has a definite material structure which is subject to investigation and measurement makes it possible to apply various forms of description and characterization to the mechanism, including the method of the general theory of systems. However, the problem of the classification of cybernetic systems remains unsolved. Author

N70-39358# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology.
VISUAL RESPONSE OF THE INTERPRETER
E. C. Gregg [1969] 19 p refs Presented at the 1st Bien. Conf. on Quant. Organ Visualization in Nucl. Med., Miami, Fla.
(Contract W-31-109-eng-78; Grants NIH AM-06760; NIH CA-08034)
(COO-78-225; CONF-700516-2) Avail: NTIS

The factors influencing visual perception by the human eye are discussed in relation to the perception of abnormalities in radiographs and radioisotope scans examined visually. Optical manipulations to improve contrast enhancement during visual presentations are discussed. NSA

N70-39493 International Business Machines Corp., Oswego, N.Y.
TECHNIQUES FOR DEVELOPING OPTIMUM MAN/COMPUTER RELATIONSHIPS IN AEROSPACE AVIONICS SYSTEMS
W. M. Gaddes *In* AGARD Air and Spaceborne Computers Apr. 1970 p 57–72 refs (See N70-39489 22-08)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (Attn. Mr. A. L. Candido)

Limitations in the man/computer interface reflect the lack of analysis and testing during the design phase which insure that the use of man in the system as a decision maker is enhanced and his contribution to system effectiveness is optimized. A method is described for insuring that appropriate functions are assigned to the man and that the man/computer interface design provides the necessary and sufficient information and control response for optimum man/computer communication. Author

N70-39494 Elliott Bros., Ltd., London (England).
NEW COMPUTING DEVICES AND SPECIAL AIDS
P. B. Rayner *In* AGARD Air and Spaceborne Computers Apr. 1970 p 73–86 (See N70-39489 22-08)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (Attn. Mr. A. L. Candido)

Some of the methods of interfacing with the computer, transmitting data, and displaying it to the crew are examined, along with an example where special computing methods were locally used to produce overall improved system performance. In an airborne application there are four main types of display which must be considered: head-up displays; horizontal situation displays, including projected map systems; CRT data displays; and other numeric and pointer displays. The application and development of each of these types of display is discussed. Current work in the field of technology development is considered in relation to an integrated approach to avionic displays. Author

N70-39541*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
RESEARCH ON NEW TECHNIQUES FOR THE ANALYSIS OF MANUAL CONTROL SYSTEMS Progress Report, 15 Jun. 1969–15 Jun. 1970
George A. Bekey and Anil V. Phatak 15 Jun. 1969 30 p refs
(Grant NGR-05-018-022)
(NASA-CR-113592; USCEE-394; PR-9) Avail: NTIS CSCL 05H

The application of statistical decision theory to the subject of manual adaptive control is reported. Application of the results to particular control situations by computer simulations is considered. Research on the modeling of neuromuscular systems and study of human eye movements during fixation on a steady target are discussed, with possible application in formulating mathematical models of human controllers. R.B.

N70-39620# Forschungsinstitut fuer Militaerische Bautechnik, Zurich (Switzerland).
RADIATION PROTECTION OF THE PUBLIC IN A NUCLEAR CATASTROPHE
J. Pretre and H. Brunner May 1969 101 p refs In GERMAN
(MB-69-7) Avail: AEC Depository Libraries

Surface explosions of nuclear weapons were assumed to occur either accidentally or intentionally outside the borders of Switzerland. Fallout effects on the Swiss population were discussed. Four main areas were covered: properties of radioactive particles, dispersion of particles by wind, protective measures, and radiosensitivity of man. Some of the conclusions of the conference are as follows: local fallout particles are too large to present an inhalation problem, eliminating the need for gas masks. The major danger is represented by external radiation necessitating stay in fallout shelters for at least two weeks; radioactive strontium poses a smaller internal radiation hazard than previously assumed; radioactive iodine isotopes, on the other hand, are more hazardous than expected, especially to children. Problems of the recovery phase are discussed. NSA

N70-39646*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HUMAN FACTORS SYSTEMS SRT
In its Res. and Advanced Devel., Vol. 2 15 Feb. 1970 p 463–468 (See N70-39642 22-34)
Copyright. Avail: NTIS HC $10.00/MF $0.65

Man-machine concepts required for remote control of unmanned planetary and lunar roving vehicles are discussed. Requirements and techniques for integrating man-machine functions into the control system are investigated, and the acquired knowledge is applied to laboratory studies and projects. Author

N70-39716* National Aeronautics and Space Administration, Washington, D.C.
NASA SAFETY MANUAL. VOLUME 1: BASIC SAFETY REQUIREMENTS
Jul. 1969 92 p refs Supersedes NHB-1700.1
(NASA-TM-X-66319; NHB-1700.1(V1); NHB-1700.1) Avail: NASA Scientific and Technical Information Div., Washington, D.C. CSCL 13L

The basic requirements are presented for system, industrial, aviation, and public safety. System safety concerns itself primarily with safety aspects of aerospace flight hardware, whether for manned or automated space systems. Astronaut safety is an important aspect of system safety. System safety is to be emphasized throughout the life cycle of these systems, from inception through end use. Industrial safety involves the safety of personnel and property in day-by-day operations, not only within facilities, but in the transportation of people and things. There exists a strong relationship with industrial hygiene activities, and with the system safety aspects of many fabrication, transport, and test activities. Aviation safety is intended to assure adequacy of safety in the NASA aviation activities of R and D, proficiency, program support, and administrative flying. Public safety activities are aimed at protection of the general public and public property from the harmful effects of NASA operations. Author

N70-39735# American Foundation for the Blind, New York.
IEEE TRANSACTIONS ON MAN-MACHINE SYSTEMS Final Report
William R. Ferrell, ed. Mar. 1970 128 p refs Proc. of Tactile Display Conf., Menlo Park, Calif., 3-4 Apr. 1969 *Its* Vol. MMS-11, No. 1
(Grant AF-AFOSR-1728-69)
(AD-708164; AFOSR-70-1659TR) Avail: NTIS CSCL 5/8

A conference on tactile displays was held at Stanford Research Institute, Menlo Park, California, during April 3-4, 1969. A major objective of this conference was to examine current neurophysiological and psychological theories to determine the extent that a rational basis for the design of dynamic tactile displays could be developed. There were about fifty attendees at this conference and 26 papers were presented on topics ranging from neurophysiology to psychology to engineering applications. This special issue consists of reviewed papers derived from selected presentations at this

conference plus the addition of several related papers that were submitted after the conference. This conference differed from other recent conferences on the sense of tough primarily in its concern for engineering and applications. This special issue mirrors the divergent aspects of the conference by presenting papers ranging from basic science to engineering applications. Author (TAB)

N70-39842# Stanford Univ., Calif. Dept. of Computer Science.
AN INFORMATION PROCESSING MODEL OF INTERMEDIATE-LEVEL COGNITION
Joseph D. Becker May 1970 137 p refs
(Contract ARPA SD-183)
(AD-708082; SU-AIM-119) Avail: NTIS CSCL 6/4

The report describes a formal information-processing model of an intermediate-level cognitive system. The model includes memory structures for the storage of experience, and processes for responding to new events on the basis of previous experience. In addition, the proposed system contains a large number of mechanisms for making the response-selection process highly efficient, in spite of the vast amount of stored information that the system must cope with. These devices include procedures for heuristically evaluating alternative subprocesses, for guiding the search through memory, and for reorganizing the information in memory into more efficient representations. Author (TAB)

N70-39843# Stanford Univ., Calif. Dept. of Computer Science.
MIND AND BRAIN, AGAIN
Kenneth Mark Colby 25 Mar. 1970 13 p
(Contract ARPA SD-183; Grant PHS-MH-06645-08)
(AD-708081; SU-AIM-116) Avail: NTIS CSCL 6/4

Classical mind-brain questions appear deviant through the lens of an analogy comparing mental processes with computational processes. Problems of reducibility and personal consciousness are also considered in the light of this analogy. Author (TAB)

N70-39877# Texas Univ., Austin. Electronics Research Center.
DIGITAL TECHNIQUES FOR THE APPROXIMATE IDENTIFICATION AND SIMULATION OF THE RESPIRATION-HEARTRATE SYSTEM
Donald R. Chick and Baxter F. Womack 1 Apr. 1970 154 p refs
(Contract F41609-68-C-0020; Grants AF-AFOSR-0786-67E; AF-AFOSR-1792-69)
(AD-708158; AFOSR-70-1375TR; TR-85) Avail: NTIS CSCL 6/2

The problem of determining a digital computer model for relating heart rate variations to respiration and other nonrandom factors is considered. The respiratory signal is a measured signal while the other nonrandom factors are unmeasurable, the sum of which is called a nonrespiratory signal. The model is derived from heart beat times and sampled values of the respiratory signal. A process is developed whereby the heart beat times are converted to a uniformly sampled heart rate signal. This allows a sampled-data model to be used to approximate the respiration-heartrate system which is assumed to be continuous. The respiratory signal is the system input and the heart rate signal is considered to be the sum of the system output, the nonrespiratory signal and noise. Several identification methods are considered for determining the parameters of the respiration-heartrate system transfer function. An on-line type identification method using instrumental variables is developed so that indefinite lengths of data may be used. Experimental data from several subjects are processed to illustrate the usefulness of the methods developed. Author (TAB)

N70-39880# Stanford Univ., Calif. Dept. of Computer Science.
STANFORD ARTIFICIAL INTELLIGENCE PROJECT
John McCarthy, Edward Feigenbaum, and Joshua Lederberg Apr. 1970 79 p refs
(Contract ARPA SD-183; Grant PHS-MH-06645-08)
(AD-708087; SU-AIM-117) Avail: NTIS CSCL 6/4

Current research is reviewed in artificial intelligence and related areas, including representation theory, mathematical theory of computation, models of cognitive processes, speech recognition, and computer vision. Author (TAB)

N70-39891# Human Resources Research Organization, Alexandria, Va.
A STUDY OF THE US COAST GUARD AVIATOR TRAINING REQUIREMENTS
Eugene R. Hall, Paul W. Caro, Jr., Oran B. Jolley, and Gilbert E. Brown, Jr. Dec. 1969 103 p refs
(Contract DOT-CG-92556A)
(AD-707677; HUMRRO-TR-69-102) Avail: NTIS CSCL 5/9

An analytical study was conducted to define desired functional characteristics of modern, synthetic flight training equipment for the purpose of producing potentially better qualified aviators through a combination of aircraft and simulator training. Relevant training which aviators receive in preparation for specific aircraft duties and training requirements for Coast Guard aviation are discussed. To meet these objectives, a comprehensive study of aviator requirements during operational missions was undertaken. The search and rescue (SAR) mission was chosen for the analysis, and missions were chosen to represent operations in each of the four aircraft used by the Coast Guard primarily for the SAR. Author (TAB)

N70-39893# Naval Personnel Research Activity, San Diego, Calif.
HUMAN FACTORS METHODS DEVELOPMENT AND TEST 2: EVALUATION OF THE AUTOMATED OPERATIONAL SEQUENCE DIAGRAM (OSD)
Orvin A. Larson and Joe E. Willis May 1970 42 p refs
(AD-707719; SRM-70-17) Avail: NTIS CSCL 5/9

The report documents an evaluation of an automated version of the operational sequence diagram (OSD) for use in personnel research. Automation of the OSD herein refers to the use of alphanumeric characters to replace geometric symbols and the use of non-computerized automatic data processing (ADP) methods to produce the OSD. In-house personnel researchers were surveyed to determine the current usage of OSDs and the user perceived strengths and weaknesses of OSDs for personnel research. Three variations of a basic automated OSD were developed and evaluated. Two of the automated OSD formats were evaluated by application to Navy weapon and support systems which were under development. Author (TAB)

N70-39922* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RESUSCITATION APPARATUS Patent
Laurence M. Christman, inventor (to NASA) Issued 18 Jan. 1966 (Filed 1 May 1963) 8 p Cl. 128-29
(NASA-Case-XMS-01115; US-Patent-3,229,689; US-Patent-Appl-SN-277404) Avail: US Patent Office CSCL 06K

A method and apparatus for delivering oxygen intrapulmonically, with minimum danger to the subject by even an inexpert operator, is described. With the intermittent application of positive pressure, a gaseous mixture comprising over 94.5% oxygen and from 2.7 to 4% carbon dioxide is delivered intrapulmonically to the subject on an intermittent basis. The selection and control of the positive pressure is adjustable as desired and in correspondence with the subject's physical needs. The apparatus includes a soft rubber oro-pharyngeal tube or airway which is adapted for insertion into the throat of the subject so that oxygen may be delivered directly to the trachea and lungs. Other parts of the apparatus include a conventional oxygen supply cylinder, an adjustable pressure regulator, and a pressure breathing mask interposed in the oxygen supply line from the regulator. P.A.B.

N70-39923*# Technology, Inc., San Antonio, Tex. Life Sciences Div.
MODIFICATION OF THE PHYSICAL PROPERTIES OF FREEZE-DRIED RICE Patent Application
Clayton S. Huber, inventor (to NASA) Filed 28 Aug. 1970 9 p
(Contract NAS9-8927)
(NASA-Case-MSC-13540-1; US-Patent-Appl-SN-68023) Avail: NTIS CSCL 06H

The method steps include first cooking rice over a low simmering heat until it is tender and edible. Then it is frozen and thawed for two complete cycles. Thereafter, the rice is again frozen and freeze dried in a vacuum sufficient to remove water from the rice by sublimation. Rehydration is accomplished by placing the rice in water at an elevated temperature and normally requires only a minute or so. The cycle of first freezing and then thawing appears to change grain porosity and permits easy and rapid sublimation of the water vapor. NASA

N70-39938# Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
COMPUTER-ASSISTED INSTRUCTION IN ENGINEERING DYNAMICS
John W. Sheldon 30 May 1970 21 p refs /tz CAI Systems Memo No. 18
(Contract N00014-68-A-0494)
(AD-707702) Avail: NTIS CSCL 5/9

The Florida State University School of Engineering Science, in cooperation with the Computer-Assisted Instruction Center, provided 29 undergraduate students with a ninety-minute CAI unit course, supplemented by a one-hour class lecture, on the dynamic nature of three dimensional rotations and Euler angles. The area of Euler angles was selected because, despite its essentiality in problem working in three-dimensional rotations of a rigid body, it has been a stumbling block to students in dynamics. Euler angles are difficult to visualize and have mathematical properties which are unfamiliar to most undergradustes. Utilizing graphic presentations and branching capabilities of CAI to combat these learning difficulties, the CAI program contained three problems in ascending order of difficulty, designed to link the physical geometry of the problem situation with the vector equation derived in class lecture. Although the final problem was typical of previous homework problems, students indicated that they did not consider the question difficult. In addition, students indicated that they considered the CAI program an interesting and effective teaching aid which they would like to see further utilized. Author (TAB)

N70-39994# Texas Univ., Austin. Electronics Research Center.
DIASTOLIC ARTERIAL BLOOD PRESSURE MEASUREMENT BY AN OCCLUSION CUFF: MICROPHONE TECHNIQUE
James E. Allred, A. J. Welch, P. C. Richardson, and F. B. Vogt
15 Jan. 1970 70 p refs
(Grant AF-AFOSR-1792-69)
(AD-708157; TR-81; AFOSR-70-0446TR) Avail: NTIS CSCL 6/12

The report describes a technique for automating the measurement of indirect systolic and diastolic blood pressure. Characteristics of the K sound are described which may provide a better criteria for detecting diastolic pressure than the disappearance of the sound. From the results of this study recommendations are made for an extensive investigation of the use of K sounds for the determination of diastolic pressure. Author (TAB)

N70-40004# Naval Training Device Center, Orlando, Fla.
PROCEEDINGS OF THE ANNUAL NAVAL TRAINING DEVICE CENTER AND INDUSTRY CONFERENCE
1969 301 p refs Conf. held at Orlando, Fla., 18-20 Nov. 1969
(AD-707757; NAVTRADEVCEN-IH-173) Avail: NTIS CSCL 5/9

A compilation of papers is presented on a variety of technical subjects relating to training device technology. The conference theme, Cost Effectiveness of Training Devices, provided a common ground for the exchange of new ideas and discussion of mutual problems. Author (TAB)

N70-40034*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Lab.
STUDIES OF HUMAN DYNAMIC SPACE ORIENTATION USING TECHNIQUES OF CONTROL THEORY Status Report, Jul. 1969 – Jun. 1970
L. R. Young and Y. T. Li Jun. 1970 55 p refs
(Grant NGL-22-009-025)
(NASA-CR-113593) Avail: NTIS CSCL 05E

Research and development is reported in the field of dynamic space orientation. Specific areas of accomplishment include: (1) display systems; (2) manual control; (3) visual systems; (4) vestibular functions; (5) cybernetics; (6) computer development and laboratory facilities; (7) medical applications; and (8) life support in unusual environments. D.L.G.

N70-40053# Stanford Univ., Calif. Dept. of Computer Science.
SOME IMPLICATIONS OF PLANARITY FOR MACHINE PERCEPTION
Gilbert Falk Dec. 1969 29 p refs
(Contract ARPA SD-183)
(AD-708085; SU-AIM-107) Avail: NTIS CSCL 6/4

The problem of determining the shape and orientation of an object based on one or more two-dimensional images is considered. For a restricted class of projections it is shown that monocular information is often nearly sufficient for complete specification of the object viewed. Author (TAB)

N70-40067# Stanford Univ., Calif. Dept. of Computer Science.
GENERALIZATION LEARNING TECHNIQUES FOR AUTOMATING THE LEARNING OF HEURISTICS
D. A. Waterman Jul. 1969 77 p refs
(Contract ARPA SD-183; ARPA Order 457)
(AD-708073; SU-AIM-102) Avail: NTIS CSCL 6/4

The paper investigates the problem of implementing machine learning of heuristics. First, a method of representing heuristics as production rules is developed which facilitates dynamic manipulation of the heuristics by the program embodying them. Second, procedures are developed which permit a problem-solving program employing heuristics in production rule form to learn to improve its performance by evaluating and modifying existing heuristics and hypothesizing new ones, either during an explicit training process or during normal program operation. Third, the feasibility of these ideas in a complex problem-solving situation is demonstrated by using them in a program to make the bet decision in draw poker. Finally, problems which merit further investigation are discussed, including the problem of defining the task environment and the problem of adapting the system to board games. Author (TAB)

N70-40096# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
MIXED-INITIATIVE MAN-COMPUTER INSTRUCTIONAL DIALOGUES Final Report, 1 Feb. 1969 – 28 Feb. 1970
Jaime R. Carbonell 31 May 1970 216 p refs
(Contract N00014-69-C-0233)
(AD-707782; BBN-1971) Avail: NTIS CSCL 5/9

The main purpose of the research was to show that a new type of computer-assisted instruction (CAI), in many respects more powerful than existing ones, is feasible, and to demonstrate by example some of its major capabilities. In order to do that, a set of computer programs, the SCHOLAR system, was written. Both the conception and the implementation of this system are discussed in detail. Actual on-line protocols of the usage of

SCHOLAR are included. The present approach to CAI can be defined as being information-structure-oriented (ISO) because it is based on the utilization of a symbolic information network of facts, concepts, and procedures. SCHOLAR is capable to generate out of its information network the material to be presented to the student, the questions to be asked to him, and the corresponding expected answers. SCHOLAR can also utilize its information network to answer questions formulated by the student. As a consequence, SCHOLAR is capable of maintaining a mixed-initiative dialogue with the student. This dialogue takes place in a subset of English.
Author (TAB)

N70-40108# General Electric Co., Philadelphia, Pa. Re-Entry and Environmental Systems Div.
CLOSED-CYCLE RESPIRATOR DEVELOPMENT PROGRAM Annual Report, Jun. 1969—Jun. 1970
John T. Kaiser and Richard Bingman 24 Jun. 1970 91 p
(Contract N00014-69-C-0329)
(AD-708035; RDP-019) Avail: NTIS CSCL 6/12

A description is given of a medical respirator based on the technology of closed cycle life support systems. Four prototype units were designed, fabricated and delivered to the National Naval Medical Center, Bethesda, Maryland for laboratory and clinical evaluation. System performance requirements were selected to meet the needs of military use and the overall design was bounded by the requirement for portability and extended autonomous operation. An eleven month program starting in June, 1969, translated these requirements to prototype hardware which underwent comprehensive performance testing at the component, sub-system and system levels prior to delivery. This testing amply demonstrated the capability of the prototype systems to satisfy the performance requirements. This report summarizes the design and development efforts addressed to defining the prototype configuration and presents a complete physical description of the system. In addition, system calibration and test procedures, along with typical results, are presented.
Author (TAB)

N70-40174# Naval Civil Engineering Lab., Port Hueneme, Calif.
SEALAB 3: DIVER'S ISOTOPIC SWIMSUIT-HEATER SYSTEM
John J. Bayles and Douglas Taylor May 1970 126 p refs
(AD-708680; NCEL-TN-1087) Avail: NTIS CSCL 6/17

The Atomic Energy Commission and the Deep Submergence Systems Project Office included the development and evaluation of an isotopic swimsuit heating system in the SEALAB III program to demonstrate a use of atomic energy as a method for providing supplemental heat to divers. The task of developing a swimsuit heating package was assigned to the Naval Civil Engineering Laboratory, Port Hueneme, California. The package utilizes AEC furnished Plutonium 238 capsules for heating water which is pumped through a closed-cycle system including a divers undergarment fitted with closely spaced plastic tubing. The diver wears a wet suit over this undergarment to aid in retaining the heat provided. The package or isotope backpack segment is designed to be attached to a modified Mark VIII mixed gas breathing apparatus backpack. The specifications based upon available information at the time of initial development stages, did not provide for sufficient isotope to produce adequate supplemental heat. However, the final backpack design did not materially affect the divers capabilities and the system was successfully tested with respect to its design operational characteristics.
Author (TAB)

N70-40247# Army Behavior and Systems Research Lab., Arlington, Va.
MAINTAINING TARGET DETECTION PROFICIENCY THROUGH TEAM CONSENSUS FEEDBACK
John T. Cockrell Dec. 1969 29 p
(AD-707376; BESRL-TRN-219) Avail: NTIS CSCL 5/9

The document reports on investigation of the effectiveness of team consensus feedback proficiency maintenance methods for maintaining and improving the proficiency of image interpreters--specifically, determination whether the target detection skill of individual interpreters can be improved by feedback which team members generate for themselves as they compare and discuss their work.
Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N70-39041 California Univ., Berkeley.
MICROWAVE STUDY OF THE VIBRATION-ROTATION INTERACTION IN TRIMETHYLENEIMINE: THE COUPLING OF TWO VIBRATIONAL MODES
Gene Howard Meyers (Ph.D. Thesis) 1969 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-18951

From the assignment of seven vibrational satellites and the measurement of direct vibrational transitions, it was found that the energy levels occurred in near-degenerate pairs, with a large separation between the pairs. Relative intensity measurements show that the separation between successive pairs decreases and that this energy level pattern is approximately reproduced by a one mode asymmetric ring puckering potential. To reproduce the accurately measured near-degenerate splittings, it was necessary to use a coupled potential involving both the ring puckering and the N-H inversion modes. A molecular model was set up to simulate the vibrational motion in a computer program for an input set of bond lengths, equilibrium ring angles, bending force constants, and torsional barriers.
Dissert. Abstr.

N70-39045# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
CURIUM PROCESS DEVELOPMENT. 4: EQUIPMENT DEVELOPMENT AND TESTING
Albert A. Kishbaugh, Harcourt Bull, III, George W. Gibson, Jr., and Lewis F. Landon Sep. 1969 70 p refs
(Contract AT(07-2)-1)
(DP-1146) Avail: NTIS

The major equipment required for separating curium, americium, and californium and for preparing purified curium and americium oxides in the Curium Processing Facility of the Savannah River Laboratory was tested under simulated process conditions prior to installation into three shielded cells. Modifications to the equipment were made where necessary for proper performance; operating procedures were developed to ensure satisfactory process control.
Author (NSA)

N70-39052# Los Alamos Scientific Lab., N.Mex.
HIGH PRECISION FLAME PHOTOMETER METHOD FOR SIMULTANEOUS DETERMINATION OF SODIUM AND POTASSIUM IN DILUTE ELECTROLYTES
E. I. Onstott, Edward F. Thode (N.Mex. State Univ.), Kermit L. Holman (N.Mex. State Univ.), and J. Steven Boothe (N.Mex. State Univ.) 14 Apr. 1970 4 p refs
(Contract W-7405-eng-36)
(LA-4414) Avail: NTIS

A method for precise, simultaneous determination of sodium and potassium in water sample with a commercial flame photometer is described. Sodium and potassium concentrations in the range 1.5 to 2.5 meq/l were determined with a prediction of better than

0.4%. Data for concentration change ratios of Na(+)/K(+) due to mobility differences were found to correlate to a very high degree with r = 0.996 for n = 32. The mobility ratios computed from these data agree closely with the mobility ratio computed from conductance measurements under similar conditions. Author

N70-39061 Wisconsin Univ., Madison.
REACTIONS OF HOT TRIFLUOROMETHYL RADICALS AND HOT HYDROGEN ATOMS PRODUCED PHOTOCHEMICALLY IN THE GAS PHASE
Richard A. Fass (Ph.D. Thesis) 1969 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 12362

The purpose of the work was to investigate the distribution of energy between vibrational and translational modes of CF3 radicals formed in the photodissociation of CF3I and CF3Br, and to study the energy dependence of the hydrogen abstraction reactions of hot CF3 radicals and of hot hydrogen atoms. Dissert. Abstr.

N70-39067 Wisconsin Univ., Madison.
A THERMODYNAMIC AND A KINETIC STUDY OF DEOXIDATION OF COPPER ALLOYS USING AN ELECTROCHEMICAL TECHNIQUE
Chitta Ranjan Nanda (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-12400

The studies of the thermodynamic behavior of oxygen in liquid copper both by gas equilibrium methods and electrochemical methods were reviewed and the thermodynamic behavior of oxygen in molten copper and copper-tin, copper-silver and copper-silicon alloys at 1135 C and at low oxygen levels were studied using an electrochemical technique. The kinetics and mechanisms of mass transfer both in aqueous and metallic systems were reviewed. The various chemical engineering aspects of gas bubble formation in aqueous as well as in metallic systems were also reviewed. The kinetics of deoxidation of copper containing oxygen (i.e., low oxygen levels) using CO bubbles were studied with due emphasis on mechanisms of mass transfer, effects of alloying element, e.g. tin and silver, temperature, rates of CO and bubble sizes. Comparison of the data on behavior of oxygen in molten copper of this investigation at 1135 C and at low oxygen levels with the recent electrochemical studies on copper-oxygen system revealed good agreement. Dissert. Abstr.

N70-39104 California Univ., Berkeley.
SPECTROSCOPIC AND KINETIC STUDIES OF IODINE MONOFLUORIDE CHEMILUMINESCENCE
Stephen David Gabelnick (Ph.D. Thesis) 1969 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-18921

Chemiluminescence from electronically excited iodine monofluoride was observed under flow conditions in the room temperature gas-phase reaction of molecular iodine and fluorine. Observations were made throughout the visible wavelength region from 4300 to 7300 A under varying conditions of reactant flow rates, total cell pressure, and partial pressure of inert diluent gas. Between pressures of 20 and 100 mtorr, substantial changes in the relative intensities of band progressions were detected. Quantitative interpretation of spectral features requires knowledge of the transition matrix elements calculated by first constructing Rydberg-Klein-Rees potential curves from known spectroscopic data and then evaluating Franck-Condon overlap integrals based on wave functions obtained from numerical solution of the Schroedinger wave equation using the RKR potentials. A variational method for obtaining the transition-moment function Re(r) from low-resolution spectra is presented. Dissert. Abstr.

N70-39117 Rensselaer Polytechnic Inst., Troy, N.Y.
A DIFFUSION-THERMAL IONIZATION SOURCE FOR THE MASS SPECTROMETRIC ASSAY OF TRACE METALS
Willard Glazier Myers, Jr. (Ph.D. Thesis) 1969 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-13694

The concept of this source is to utilize a diffusion mechanism in addition to thermal surface ionization, in order to obtain a higher ionization efficiency and a mass spectrum which is not obscured by impurities or superposed molecular spectra. The sample element together with its isotopic spike is encapsulated within an appropriate filament that is made of a refractory metal of high work function. After insertion in the mass spectrometer, the filament is operated at a high temperature, which causes the sample atoms to diffuse to the exterior surface and become ionized by thermal ionization. There are several advantages of this source over conventional ion sources. Three techniques or filament configurations were investigated to test the sample encapsulation condition; physical vapor deposition, spot welding, and tubular containment. Dissert. Abstr.

N70-39125# California Univ., Berkeley. Lawrence Radiation Lab.
MASS TRANSFER COEFFICIENTS AND INTERFACIAL AREA FOR GAS ABSORPTION BY AGITATED AQUEOUS ELECTROLYTE SOLUTIONS
C. W. Robinson and C. R. Wilke Mar. 1970 36 p refs Presented at Chem. Eng. Conf., Sydney Supported in part by AEC (Contract W-7405-eng-48)
(UCRL-19570; CONF-700804-1) Avail: NTIS

The oxygen mass transfer characteristics of several aqueous electrolyte solutions of varying ionic strength are reported for a wide range of agitation-aeration intensity in a 2.5 litre fully-baffled stirred tank. Unsteady state oxygen probe response methods are described which permit measurement of the overall liquid phase physical mass transfer coefficient with minimum experimental complexity. Mathematical analysis of and computer solution for probe response are outlined. A simultaneous measurement technique involving concurrent chemical absorption of carbon dioxide and desorption of oxygen is proposed for separately evaluating the liquid-film coefficient and the specific interfacial area. Preliminary experimental results are given. Author

N70-39126# California Univ., Livermore. Lawrence Radiation Lab.
COMMENTS ON ONE AND TWO DIMENSIONAL INTERACTIONS IN SOLIDS: VAN DER WAALS COMPOUNDS AND THEIR APPLICATIONS
Edward Catalano 25 Mar. 1970 29 p refs
(UCRL-50838) Avail: NTIS

A literature survey was made to search for compounds, either existing or molecularly engineerable, with interactions restricted to one or two dimensions. Real systems suitable for use as models of such restricted interactions were sought for comparison with similarly restricted theoretical models. A number of promising candidates were selected from metal-metal bonded cluster compounds, linear chain compounds, and inorganic layer-structure compounds. The most promising were found to be the van der Waals or inclusion compounds. Many interesting possibilities are offered by the channel inclusion complexes, including urea and thiourea complexes with fatty acids, thiourea complexes with halogenated hydrocarbons, and starch-iodide and benzamide-iodide complexes, as well as inorganic complexes with urea and thiourea and transition-metal complexes with magnesium. Promising sandwich inclusion complexes include graphite intercalation complexes and layer lattice cyanides. Least promising of the inclusion compounds are the clathrates and zeolites. Author

N70-39130# Lyon Univ. (France). Inst. de Physique Nucleaire.
OXYGEN DETERMINATION IN SILICON BY ACTIVATION BY ALPHA PARTICLES [CONTRIBUTION AU DOSAGE DE L'OXYGENE DANS LE SILICIUM PAR ACTIVATION AU MOYEN DES PARTICULES ALPHA]
Jean-Paul Thomas (Ph.D. Thesis) Mar. 1970 75 p refs In FRENCH
(LYCEN-7016) Avail: AEC Depository Libraries

The validity and limits of the empirical laws on stopping powers and charged particles range in complex chemical materials are examined. The energy dispersion of the incident particles, enhanced by straggling in thick samples, introduces a distortion in the activation curves that may be calculated in simple cases. Correction factors may be introduced. Analysis is not made impossible by this dispersion, but requires the determination of the mean cross sections. In the particular case of oxygen determination in silicon, interference reactions appear at energies higher than 40 MeV and make any determination of oxygen impossible by alpha particles with an energy > 40 MeV. The surface state of the analyzed samples and the thickness of the superficial oxidized layer are examined. Those reactions could not result from diffusion processes developed on the surface. NSA

N70-39137 Michigan Univ., Ann Arbor.
A CRYSTALLOGRAPHIC AND SPECTROSCOPIC INVESTIGATION OF SEVERAL TRIMETHYLAMINE-BORON TRIHALIDE COMPLEXES
Patty Domer Hall Clippard (Ph.D. Thesis) 1969 276 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.55 Order No. 69-17983

The crystal and molecular structures of the (CH3)3NBCl3, -BBr3, and -BI3 adducts were determined by single crystal X-ray diffraction. Although the crystal structures differ from that of the BF3 complex, the molecular structures of all four adducts possess effective C sub 3v symmetry with a staggered conformation. Isotopic varieties of (CH3)3NBF3, -BCl3, -BBr3, and -BI3 were prepared which include substitution of deuterium, boron- 10, boron-11, and nitrogen-15. Infrared and far infrared spectra of these compounds in the solid state have been obtained in the region 1/40-4000 cm. Polarized infrared spectra have been obtained of oriented single crystals in the range from 1/250-4000 cm. Normal coordinate analyses were carried out based on all isotopic data, using the Wilson GF method. The trend in the B-N force constant for the chloro, bromo, and iodo complexes agrees with the trend found in other properties of these complexes. Dissert. Abstr.

N70-39140# Los Alamos Scientific Lab., N.Mex.
THE SOLUBILITIES OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. 16: YTTRIUM
David F. Bowersox 2 Apr. 1970 3 p refs
(LA-4354) Avail: NTIS

The solubility of yttrium in liquid plutonium increases with temperature from 0.44 wt % at 700 C to 2.55 wt % Y at 990 C. The data fit the equation log N sub Y = 1.12 – 2970/T, where N sub Y is the mole fraction of yttrium in a saturated solution at absolute temperature, T. Author (NSA)

N70-39149 University of Southern Calif., Los Angeles.
LATTICE VIBRATIONS OF SOLID ALPHA-NITROGEN AND ATOM-ATOM INTERMOLECULAR POTENTIAL. 1. INTENSITIES OF THE FAR-INFRARED ABSORPTION LINES OF SOLID CARBON DIOXIDE. 2
Teh Soong Kuan (Ph.D. Thesis) 1969 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-19382

For solid alpha-nitrogen, the librational lattice modes observed by Raman scattering, and the intensity ratio between the two far infrared absorptions of the translational lattice modes are shown to be strongly dependent on the anisotropic intermolecular potential. A two-parameter, atom-atom intermolecular potential using Lennard-Jones 6-12 terms is proposed. Using this potential, it is possible to fit the lattice constant, the crystal energy, four optical mode frequencies, and the intensity ratio of the IR absorption lines. The potential is consistent with the relative orientation of molecules in the crystal. The absolute intensities of the translation lattice mode absorptions of solid CO2 at liquid helium temperature were measured using a high resolution, far infrared Michelson interferometer. The temperature dependence of the peak frequency, line width, and the absolute intensity of each band were also studied between 4.2 and 100 K. The total intensity of solid CO2 calculated using a theory for the far IR absorption intensities based on a quadrupole-induced dipole mechanism agreed well with experimental value. Dissert. Abstr.

N70-39165# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
GAS CHROMATOGRAPHIC ANALYSIS FOR TRACE AMOUNTS OF WATER IN SILICONES
Julie G. Dorsey, Charles W. Catlett, and Hoyt J. Tinsley 29 May 1970 12 p ref
(Contract W-7405-eng-26)
(Y-1717) Avail: NTIS

Gas chromatography has been utilized to determine very small concentrations (low ppm range) of water in silicone resins and curing agents. Since the silicone or an additive in the silicone reacts with the Karl Fischer reagent and with lithium aluminum hydride, gas chromatography is the only reliable method found to date to successfully analyze the moisture content of silicones. Author

N70-39184# Oregon Univ., Eugene.
DIFFUSION CONTROLLED REACTIONS AND EXCHANGE REACTIONS IN SOLUTION Annual Progress Report
Richard M. Noyes 3 Jun. 1970 10 p refs
(Contract AT(45-1)-1310)
(RLO-1310-16) Avail: NTIS

Various studies on radical exchanges of isobutyl iodide with iodine and armatic iodides with iodine are presented. Information is included on measuring the diffusion coefficients of hydrogen in water, mechanisms of homogeneous oscillating reactions, and polar exchanges of benzhydryl iodides with iodine. NSA

N70-39195# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
PLUTONIUM ISOTOPES DETERMINATION
M. Acena, R. Pottier, and G. Koehly 1969 42 p refs In FRENCH Presented at the 2d Spanish-French Symp. on Fuel Reprocess. and Plutonium Chem., Madrid, 12-19 Nov. 1969
(CEA-CONF-1535; CONF-691122-1) Avail: AEC Depository Libraries

Two radiometric procedures were developed for determination of Pu-236 and Pu-241 in Pu-242. The separation of uranium from plutonium and of americium from plutonium is described. The preparation of uranium, plutonium, or americium scores by electrodeposition is given. The device comprises an alpha detector and gamma detector oppositely connected. The alpha spectra of U, Pu, and Am sources and those of Pu and Am sources in alpha-gamma coincidence are given. A correction made on the residual nuclides and the aging time necessary between Pu-238 purification and its analysis have to be taken into account for the error calculation made for Pu-236. Errors are also estimated for Pu-241. The results thus obtained are found to be in agreement with those found by alpha spectrometry for Pu-236 and by mass spectrometry for Pu-241. NSA

N70-39227# Brigham Young Univ., Provo, Utah.
THERMODYNAMICS OF METAL-LIGAND INTERACTION

IN AQUEOUS SOLUTION Final Report, 1 May 1969 – 28 Feb. 1970

Reed M. Izatt and James J. Christensen 28 Feb. 1970 6 p refs
(Contract AT(11-1)-1782)
(COO-1782-1) Avail: NTIS

Research in the fields of metal-ligand systems, development of precision calorimetric equipment, and other related areas is listed in bibliographic form, indicating manuscripts published during the contract period. P.A.B.

N70-39229# Brigham Young Univ., Provo, Utah.
LOG K SUB i DELTA H/O/ SUB i, AND DELTA S/O/ SUB i VALUES FOR THE INTERACTION OF GLYCINATE ION WITH Mn(2+), Fe(2+), Co(2+), Ni(2+), Cu(2+), Zn(2+), AND Cd(2+) AT 10, 25, AND 40 DEG

R. M. Izatt, H. D. Johnston, and J. J. Christensen 15 May 1970 33 p refs
(COO-1782-5) Avail: NTIS

Values of log K sub i, Delta H(O) sub i, and Delta S(O) sub i valid at zero ionic strength and at 10, 25, and 40 deg are reported for the reaction M(2+) + iG(-) = MG(2-i) sub i, where G = glycine and M = Mn(i=1), Fe(i = 1), Co(i = 1,2,3), Ni(i = 1,2,3), Cu(i = 1,2), Zn (i = 1,2,3), and Cd(i = 1,2,3). The Delta C(O)p sub i values calculated from the temperature dependence of Delta H(O) sub i indicate that solvent effects for the various metal complexes are similar. The temperature dependence of the thermodynamic quantities for the formation of metal-glycinate complexes are similar for each of the metal glycinate systems studied. Values pK, Delta H(O), and Delta S(O) valid at zero ionic strength and at 10, 25, and 40 deg are reported for proton ionization from glycine, and a value of Delta C(O)p is estimated from the variation of the Delta H(O) values with temperatures. Author

N70-39233# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Radiochemie.
DETERMINATION OF URANIUM IN MINERALS BY X-RAY FLUORESCENCE SPECTROSCOPY

J. Neuber Jan. 1970 41 p refs In GERMAN
(NP-18228) Avail: AEC Depository Libraries

The uranium content of minerals of various compositions and origins were determined by X-ray fluorescence spectroscopy. It is shown that for minerals that contain more than 3% uranium the determination can be carried out simply and exactly by dissolution of the minerals in aqueous solutions and use of plutonium as an internal standard. For minerals that contain between 3 and 0.05% uranium it was better to measure the samples in molten salt or completely undiluted. NSA

N70-39234# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Heisse Chemie.
DETERMINATION OF FREE ACID IN PLUTONIUM (IV) SOLUTIONS

D. Thiele and W. Baehr Jan. 1970 12 p refs In GERMAN
(KFK-1133) Avail: AEC Depository Libraries

The determination of free acid in nitric acid solutions of plutonium(IV) (up to 0.5 M) is described. PU(4) is reduced to Pu(3+) with mercury. Separation of reagents and reaction products is not needed before acidimetric titration. Uranium in a ratio of 10 to 1 plutonium does not interfere. Pu(VI) in larger amounts should not be present. The relative standard deviation is 0.4 to 1%. Author (NSA)

N70-39319# Kennecott Copper Corp., Salt Lake City, Utah. Metal Mining Div.
WITH CURRENT TECHNOLOGY CAN COPPER SMELTERS MEET PROPOSED AIR QUALITY STANDARDS?

James F. Foard *In* Ariz. Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 101 – 127 refs (See N70-39313 22-04)
Avail: NTIS

Contentional copper smelting practices are described; the nature of the problems facing smelters in controlling emissions are indicated. Reverberatory, converter, and roaster offgas streams are discussed with relation of the difficulties involved in their control. Specific technological developments which may have application in alleviating the emission problems are then described and evaluated, including flash smelting, the use of tonnage oxygen, dry sorption of SO2, wet soprtion of SO2 and alternate metallurgical processes which avoid the formation of SO2. Sulphur by-products produced in the various processes are mentioned with relation to their bearing on process feasibility. Efforts being made by the copper industry in emission control involve evaluation of technological alternatives and determination of the level of emission control that should be sought. A bibliography is included. P.A.B.

N70-39322# Magma Copper Co., San Manuel, Ariz.
TECHNOLOGICAL AND ECONOMIC LIMITS OF SMOKE CONTROL

Wesley P. Goss *In* Ariz. Univ. Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 154-161 Presented at the Symp. on Mining and Ecology in the Arid Environment, Tucson, Ariz. 22-27 Mar. 1970 (See N70-39313 22-04)
Avail: NTIS

The copper smelting industry is discussed with regard to the sulfur dioxide which it generates and to ways of reducing the amount of the gas vented to the atmosphere. Efforts to find economical methods of converting the sulfur dioxide gas into a useful and disposable product are considered, including the production of liquid sulfur dioxide, ammonium sulfate, sulfuric acid, and elemental sulfur in solid form. P.A.B.

N70-39328# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
EFFECTS OF SLOW MASS TRANSFER WHEN USING MICROPOROUS ADSORBENTS IN GAS-SOLID CHROMATOGRAPHY

A. K. Moreland and L. B. Rogers [1970] 44 p refs
(Contract AT(11-1)-1222)
(COO-1222-37) Avail: NTIS

The elution behaviors of CH4, C2H6, n-C3H8, iso-C4H10, Ar, O2, N2, and SF6 were studied in A-type zeolites containing K(+), Na(+), Li(+), Sr(+2), Ca(+2), and Mg(+2). Temperature and flow-dependent tailing of peaks and changes in retention volume with flow rate were found for those adsorbates able only to partially penetrate the pores. When diffusivities were large enough to allow total access to the pores, molecular size and the degree of adsorption had significant effects on HETP values. Author

N70-39341# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
EXPERIMENTS ON CHEMICAL IDENTIFICATION OF SPONTANEOUSLY FISSIONABLE ISOTOPE OF ELEMENT 105

I. Zvara, V. Z. Belov, Yu. S. Korotkin, M. R. Shalaevskii, V. A. Shchegolev et al 1970 13 p refs In RUSSIAN
(JINR-P12-5120) Avail: AEC Depository Libraries

Experiments were performed on the chemical separation of radioactive products obtained in the bombardment of Am-243 with accelerated Ne-22 ions (compound nucleus – element 105) by adsorption of gaseous chlorides from flowing carrier gas on the surface of a glass tube, over which a temperature gradient was established. It was found, that the chloride of the spontaneous fission activity present is less volatile than niobium chloride but not less volatile than hafnium chloride. Such volatility properties are predicted for element 105, ekatantalum. Eighteen decay events were detected. Author (NSA)

N70-39355# Oak Ridge National Lab., Tenn. Office of Language Services.
PHASE EQUILIBRIA IN THE SYSTEMS NEPTUNIUM OXIDE/RARE EARTH OXIDES (Ho, Er, Tm, Yb, Lu)
C. Keller et al May 1970 5 p refs Transl. into ENGLISH from J. Inorg. Nucl. Chem. (London), v. 31, 1969 p 3421–3426
(ORNL-tr-2313) Avail: NTIS

The systems neptunium oxide–oxides of the rare earths (RE = Ho, Er, Tm, Yb, Lu) investigated between 1250 and 1550 C at p(O2) = 1 atm showed three one-phase and two-phase regions. In the neptunium-rich part a solid solution region with fluorite structure was found which increased slowly with rising temperature. The 1:1 reaction products (Np, Re)O2 showed less thermal stability than the analogous double oxides with uranium. The rhombohedral region was identical in all systems with the 1 : 6 compound NpO3 6REO and no rhombohedral phase range was observed. The maximum solubility of neptunium oxide in the rare earth oxides was 2 mole per cent and, similarly, increased slowly with temperature. In all mixed oxides investigated neptunium was oxidized more or less to oxidation states higher than four, independent of the various phase regions. Author (NSA)

N70-39398# Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
MOLECULAR ELECTRONIC SPECTROSCOPY OF ISOELECTRONIC SERIES: LINEAR TRIATOMIC GROUPINGS CONTAINING SIXTEEN VALENCE ELECTRONS
John Wayne Rabalais (Ph.D. Thesis) May 1970 170 p refs Supported in part by AEC and AF
(TID-25426) Avail: NTIS

The electronic structure of linear triatomic sixteen-valence-electron molecules and ions and several slightly-perturbed linear triatomic systems were investigated. Electronic absorption spectra of these molecules and ions have been determined in the ultraviolet and vacuum ultraviolet regions of the spectrum. Luminescence spectra have also been measured for some of the species. Mulliken-Wolfsberg-Helmholz (MWH) computations have been used to generate Lowdin Mo's, MO eigenvalues, total electronic energies, orbital populations, and atomic charges. These calculations are coupled with configuration interaction (CI) and spin-orbit coupling (SOC) calculations in order to obtain singlet and triplet excited states. Author

N70-39399# Louisiana State Univ., Baton Rouge. Coates Chemical Labs.
MOLECULAR ELECTRONIC SPECTROSCOPY OF ISOELECTRONIC SERIES. PART 2: LINEAR TRIATOMIC GROUPINGS CONTAINING SIXTEEN VALENCE ELECTRONS
J. W. Rabalais (Ph.D. Thesis), J. M. McDonald, V. Scheer, and S. P. McGlynn [1969] 145 p refs Sponsored by AEC and AF
(TID-25425) Avail: NTIS

The electronic spectra of triatomic sixteen valence electron molecules have been much investigated. Nonetheless, few state identifications exist. The purpose of the present work is to elicit good electronic absorption spectra for these molecules and to characterize and identify their excited electronic states. The molecules considered are: CO2, CS2, NNN(-), NO2(+), CN2(=), HgCl2, HgBr2, HgI2 OCS, NNO; NCO(-), NCS(-), NCCl NCBr, NCl, H2CCCH2, H2CCO, H2HCN, (CH3)2NCN, H2CNN, HNNN, HNCO, HNCS, CH3CH2NCO, and C5H11NNN. Author

N70-39403*# Bradford Univ. (England). Dept. of Chemistry.
THE FORMATION OF SURFACE FILMS BY ELECTRON BOMBARDMENT Final Report, Oct. 1968–Sep. 1969
M. W. Roberts, J. R. H. Ross, J. H. Wood, and W. J. Murphy *In* TRW Systems Group Advanced Spacecraft Valve Technol. Jul. 1970 refs 70 p (See N70-39401 22-15)
Avail: NTIS CSCL 07C

The determination of the mechanism of the formation of thin polymeric films from organic molecules was studied by the electron beam technique, together with the properties of the polymers, mainly from the view of their wetting characteristics. Initially, a study of the chemisorption of a possible monomer, tetramethylsilane, was made on tungsten and iron substrates. The bonding of the absorbed layer will be related to the adhesion of the polymer. Preliminary experiments on the mechanism of the polymerization reaction indicated that it probably involved the formation of negative ions at the hot filament which then polymerize on striking the substrate. The following studies are presented: (1) The mass spectrometer study of the kinetics of the reaction of tetramethylsilane with a tungsten filament, without and with a field. (2) An investigation of the production of negative ions from tetramethylsilane, butadiene, and neopentane. (3) A study of the wetting characteristics of thin polymeric films formed from perfluorobutene-2 on tungsten substrates. Author

N70-39417# Louisiana State Univ., Baton Rouge. Coates Chemical Labs.
ELECTRONIC TRANSITIONS IN MONO-OLEFINIC HYDROCARBONS
F. H. Watson, Jr. and S. P. McGlynn [1970] 19 p refs
(Contract AT(40-1)-3018)
(TID-25433) Avail: NTIS

Investigation of the onset of absorption in the spectra of liquid mono-olefins reveals that the transitions in this region are too intense to be triplet - singlet in nature. Comparison with calculated intensities and excitation energies indicates that the absorption is due to a transition. The R(3s) yields N transitions in the vapor spectra have been re-investigated and f-numbers have been estimated. Comparison with calculated intensities indicates that this transition might gain a part of its intensity via vibronic stealing from the V ← N transition. This mechanism is discussed and shown to offer a possible explanation for the vibrational structure observed in the R(3s) ← N transition of cyclopentene. Self-pressure dependence of the R(3s) ← N transition in mono-olefins indicates that the 3s Rydberg orbital is neither as diffuse nor as atomic-like as it is usually assumed to be in these molecules. Author

N70-39431# Delaware Univ., Newark. Dept. of Chemistry.
STUDIES ON PRIMARY PROCESSES IN THE RADIATION CHEMISTRY OF LIQUIDS AND ON THE MECHANISM OF THE INTERACTION OF RADIATION ON BIOLOGICALLY IMPORTANT CHEMICAL SYSTEMS Progress Report, 1 Jun. 1969–8 Jun. 1970
Conrad N. Trumbore 8 Jun. 1970 14 p refs
(Contract AT(30-1)-3383)
(NYO-3383-17) Avail: NTIS

The importance as well as the complexity, of the p-nitroso-dimethylaniline (RNO) system as a primary standard for measuring OH radical rate constants is discussed. Quantitative studies are reported on the similarities between flast protolysis and pulse radiolysis of the aqueous RNO system. The suggestion is made that photolysis of water is responsible for the observed phenomena. Increasing evidence is reported for the role of water structure in aqueous radiation chemistry and radiation biology as well as in unirradiated biological systems. Preliminary results of the effects of added structure-making and structure-breaking salts on pulse radiolysis results, as well as the formation and radiation chemistry of micelles, are reported. The remarkable resistance, higher than any other reported living system, of certain of the blue-green algae is reported. It is noted that viral attack on these algae weakens the radiation resistance of certain algae. Author (NSA)

N70-39441# Instituto de Asuntos Nucleares, Bogota, (Columbia). Seccion de Radioquimica.
DETERMINATION OF TRACES OF SELENIUM AND

TELLURIUM IN SULFUR BY NEUTRON ACTIVATION [DETERMINACION DE TRAZAS DE SELENIO Y TELURO EN AZUFRE POR ACTIVACION NEUTRONICA]
Alfred A. Arroyo and Jaime G. Toro 1968 14 p refs In SPANISH
(IAN-Q-8) Avail: AEC Depository Libraries

The method described makes it possible to assure a sensitivity of determination of 0.07 micro-gram of selenium and of tellurium in the presence of sulfur with a considerable saving of time in relation of other analytical methods of adequate precision. Repeated experiments were carried out on samples of equal selenium and tellurium content, and the results showed that the method is very consistent, i.e., the error is less than 1%. The isotopes of selenium and tellurium selected make it possible to obtain a sharp spectrum, which facilitates carrying out the analysis and avoids expensive radiochemical separations. Author (NSA)

N70-39443# Gulf General Atomic, San Diego, Calif.
SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM IN AQUEOUS SOLUTION
G. Buzzelli 13 May 1970 16 p refs
(Contract AT(04-3)-833)
(GAMD-10072) Avail: NTIS

A method was developed for determination of fission zirconium in solutions of irradiated nuclear fuels. The method is based on measurement of the absorbance of the zirconium complex with Arsenazo III in a strongly acidic aqueous solution. The zirconium is first separated by ion exchange and then determined colorimetrically. NSA

N70-39462# Iowa State Univ. of Science and Technology, Ames.
THE SYNTHESIS AND SOME PHYSICAL PROPERTIES OF REDUCED SCANDIUM CHLORIDE, BROMIDE, AND IODIDE PHASES WITH UNUSUAL STOICHIOMETRIES
Bill Crews McCollum (Ph.D. Thesis) Feb. 1970 99 p refs
(Contract W-7405-eng-82)
(IS-T-339) Avail: NTIS

The ScX3-Sc system for chloride, bromide, and iodide all contain a stable reduced phase. In no case does the phase in equilibrium with the metal have the simple dihalide stoichiometry. The reduction limit in the iodide system is ScI to 2.15 in contrast to ScX1.5 which results for the chloride and bromide systems. The phase diagram determined for the iodide system shows that ScI2.15 is the composition in equilibrium with the metal, and that it melts incongruently at 892 deg to give metal and a liquid of composition ScI2.25. There is some evidence of a homogeneity range on the iodide rich side of ScI2.15, but its extent and temperature dependence is not known. The scandium iodide is apparently isostructural with the CdI2-type forms of TiI2 and VI2 which suggests that about 5% of the cation positions in this structure are vacant and disordered. Author (NSA)

N70-39463# California Univ., Livermore. Lawrence Radiation Lab.
RECOVERY OF THE ACTINIDE-RARE-EARTH FRACTION FROM HUTCH SAMPLES
R. Quong and J. O. Cowles 7 Apr. 1970 10 p refs
(UCRL-50847) Avail: NTIS

Hutch is the most recent and most successful test of a device designed to produce large quantities to transcurium isotopes. To obtain the isotopes, samples of shot-melted rock (debris) are recovered by drilling back into the shot region. The melt is then processed to isolate and recover the actinide–lanthanide fraction. The existing debris processing facility was modified for Hutch to semicontinuous batch processing. The facility was prepared to process up to 500 kg of Hutch material. From all the material recovered, only 10 kg of high-quality debris was separated. A transcurium–rare earth fraction was isolated from this 10 kg. The chemical yield was 76%. The transcurium–rare earth product was further processed to isolate individual element and assay individual isotopes. Possible modifications to future processing operations, suggested by Hutch experience, are presented. Author (NSA)

N70-39481# Iowa State Univ. of Science and Technology, Ames.
AN ULTRAVIOLET ABSORPTION AND FLUORESCENCE STUDY OF 1, 10-PHENANTHROLINE AND RELATED COMPOUNDS IN AQUEOUS SOLUTION
Charles John Hensler (Ph.D. Thesis) Feb. 1970 149 p refs
(Contract W-7405-eng-82)
(IS-T-349) Avail: NTIS

The uv absorption spectra of the poly(1,10-phenanthroline) hydrogen aggregates are consistent with a structure which places the 1,10-phenanthrolines in the secondary hydration sphere of the hydronium ion. The fluorescence spectra of these aggregates indicate that they undergo a rearrangement after excitation and fluoresce at wavelengths characteristic of the excimers. The fluorescence band which is characteristic of the poly(1,10-phenanthroline)hydrogen aggregates also appears in concentrated basic solutions. The behavior is shown to be the result of reversible dimerization in the excited state followed by protonation of the excited-state dimer. Quenching equations were developed for reversible self-quenching in the presence of external quenchers from simple steady-state kinetics. The self-quenching constant for 1,10-phenanthroline in basic solution is reported along with the quenching constants for ammonia buffers and potassium halide salts. Author

N70-39488# Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
ELECTRONIC TRANSITIONS IN MONO-OLEFINIC HYDROCARBONS
Freddie Howard Watson, Jr. (Ph.D. Thesis) Aug. 1969 205 p refs
(Contract AT(40-1)-3018)

Mulliken-Wolfsberg-Helmholz calculations which predict certain trends as methyl groups are appended to ethylene were performed on the series of methyl substituted ethylenes. Predicted shifts in energy verify the assignment by Mulliken that the transition between 5 to 7 eV is N yields R(3s) in nature. Spin-orbit coupling calculations indicate that the weakest olefin band at approximately 2700 A is too intense to be a triplet as is usually assumed. The shifts predicted by computations for a pion yields sigma* (35.28) transition agree well with the positions of these weak bands in the absorption spectra of liquid olefins. It is postulated that the N yields R(3)s transition gains at least part of its intensity via vibronic stealing from the N yields V transition. Computations on cyclic olefins predict the possibility of several low-lying pion, pion transitions. Computations on methylenecycloalkaneg and cycloalkylideneycloalkanes reveal that sigma-strain can lead to low-lying pion yields sigma* (valence-shell) transitions. It is concluded that the 3s atomic orbital can mix appreciably, in both bonding and antibonding combinations, with valence-shell orbitals. Author (NSA)

N70-39515# Delaware Univ., Newark. Dept. of Chemistry.
STUDIES ON PRIMARY PROCESSES IN THE RADIATION CHEMISTRY OF LIQUIDS AND ON THE MECHANISM OF INTERACTION OF RADIATION WITH BIOLOGICALLY IMPORTANT CHEMICAL SYSTEMS Progress Report, 22 Mar. 1967–8 Jun. 1970
C. N. Trumbore 8 Jun. 1970 7 p refs
(Contract AT(30-1)-3383)
(NYO-3383-18) Avail: NTIS

Research progress is summarized on: energy transfer in organic liquids, low solute concentration effects in aqueous radiation chemistry, fast electron decays in pulse radiolysis, a standard for

OH radical rate constants, mechanism of radiolysis of aqueous cysteine solutions, and radiation resistance of blud-green algae.
NSA

N70-39532*# California Univ., Berkeley. Sea Water Conversion Lab.
STUDY OF PERMEABILITY CHARACTERISTICS OF MEMBRANES Quarterly Report
K. S. Spiegler, J. C. T. Kwak, D. A. Zelman, and J. Leibovitz 15 Apr. 1970 27 p Prepared for JPL
(Contracts NAS7-100; MPL-952109)
(NASA-CR-113567; QR-9) Avail: NTIS CSCL 07D

The measurement is described of diffusive and electrical transport of KOH and dissolved ZnO through the JPL 119 GX membrane bounded by concentrated KOH solution. The following measurements were performed: (1) diffusive transport of KOH and water, with membrane bounded by 5M and 1M KOH; (2) electrical transference of K(+) (or OH(-)) and water, with membrane bounded by 5M KOH; and (3) diffusive transport of ZnO dissolved in 5M KOH. Author

N70-39537# British Steel Corp., London (England). Metallurgy Div.
A COMPARISON OF ELECTRON AND X RAY EXCITATION FOR THE DETERMINATION OF ELEMENTS IN CAST IRON
W. Johnson 1970 12 p refs Supersedes MG/DA/594-67
(PB-191972; MG/D/409/70) Avail: NTIS CSCL 11F

Using chemically standardised samples of cast iron, a comparison was made of the relative merits in X-ray fluorescence analysis of excitation by W- and Cr- target X-ray tubes and by direct electrons. The advantages and disadvantages of each method are discussed and it is shown that for the heavier elements Cu, Mn and Cr, W-target excitation is satisfactory, whereas for S, P, Si and Al, Cr-target excitation is better. For Si and Al, direct electron excitation is superior to Cr-target excitation in terms of sensitivity, precision and lower limit of detection. The sources of error in X-ray fluorescence are discussed and it is shown that specimen preparation, the avoidance of contamination and chemical standardization are likely to be the factors controlling the ultimate performance of the X-ray fluorescence technique particularly for the lighter elements. Author (USGRDR)

N70-39543# George Washington Univ., Washington, D.C. Dept. of Chemistry.
THE PYROLYSIS OF TETRAFLUOROHYDRAZINE
Joseph B. Levy and Warren N. Corbin 1 Jun. 1970 27 p refs
(Contract N00014-67-C-0344)
(AD-707784; SL-101) Avail: CFSTI CSCL 7/4

The pyrolysis of tetrafluorohydrazine was studied in a passivated monel bulb over the temperature range 315-520C and at pressures from about 30-700 torr. The stoichiometry was confirmed by gas chromatographic analysis, and the reaction kinetics investigated manometrically and analytically. 6NF2 yields 4NF3 + N2. The reaction rate was found to exhibit good second order behavior at temperatures above 405C. Evidence is presented that the reaction is homogeneous and the mechanism is bimolecular.
Author (TAB)

N70-39691# Los Alamos Scientific Lab., N.Mex.
X-RAY SPECTROMETRIC DETERMINATION OF RHODIUM AND PALLADIUM IN URANIUM-BASE FISSIUM ALLOYS
E. A. Hakkila, R. G. Hurley, and G. R. Waterbury Apr. 1970 8 p refs
(Contract W-7405-eng-36)
(LA-4438) Avail: NTIS

Samples weighting 200 mg are dissolved in hydrochloric acid and fumed to incipient dryness, and the residue is dissolved in water. Yttrium and iridium are added to serve as an internal standard and as a carrier, respectively, prior to hydrolytic precipitation of rhodium, palladium, yttrium, and iridium using sodium tetrabromate and sodium bicarbonate. The precipitates are digested for 4 hr and collected by filtration on glass-fiber filter disks. The intensities of the K alpha X-rays for rhodium, palladium, and yttrium, and the L alpha sub 1 X-ray for uranium are measured, rhodium intensity is corrected for uranium overlap, and the rhodium-to-yttrium and palladium-to-yttrium intensity ratios are compared to ratios measured for samples having known compositions which are prepared in a similar manner. Author (NSA)

N70-39704# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
HIGH-PRECISION GAS CHROMATOGRAPHY
R. A. Culp, C. H. Lochmueller, A. K. Moreland, R. S. Swingle, and L. B. Rogers [1970] 17 p refs
(Contract AT(11-1)-1222)
(COO-1222-36) Avail: NTIS

A high-precision chromatograph was used for determination of the differential thermodynamic quantities of two gas-liquid systems. Individual alpha values, and consequently differential enthalpies of reaction, were determined a precision of + 0.02%. The precision in the measurement of standard motor free energies of solution was + or − 0.2%. These values represent an order of magnitude improvement over the best previously reported data. Heats of adsorption of hydrocarbons on carbon black and silica gel were also determined with a precision of + or − 0.6%. Author

N70-39721# MSA Research Corp., Evans City, Pa.
A LITERATURE SURVEY AND ANALYSIS OF MISTS 1-10 MICRON SIZE AND MOISTURE SEPARATORS. PHASE 1, TASK 1: MOISTURE SEPARATOR DEVELOPMENT
W. Julian Carter, Jr. 21 Jan. 1970 44 p refs /ts Topical Rept. No. 1
(Contract AT(45-1)-2145)
(MSAR-70-10) Avail: NTIS

The major emphasis of the search was directed toward defining the problem, isolating the observed pertinent phenomenon, answering questions on the behavior and removal of mists, and identifying the major variables. The principal categories investigated were: (1) Mists, 1-10 micron size - dissemination, behavior, sampling, size measurement and elimination. (2) Moisture separator or mist eliminator or demister - design, construction, operation and efficiency. An extensive bibliography is attached. The mechanism of inertial impaction with fine fiber mesh will probably most effectively eliminate droplets in the 1-10 micron size range.
Author

N70-39724# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
ENSEMBLE AVERAGING IN GAS CHROMATOGRAPHY
L. J. Lorenz, R. A. Culp, and L. B. Rogers [1970] 23 p refs
(Contract AT(11-1)-1222)
(COO-1222-39) Avail: NTIS

Ensemble averaging was successfully applied in gas chromatography. The normally accepted detection limit methane for the flame ionization detecter was lowered by about two orders of magnitude. Analytical useful data were obtained when the signal-to-noise ratio of the generated ensemble was greater than two. The technique should be valuable not only in gas chromatographic determinations of ultra-trace constituents, but also in fundamental chromatographic studies involving very dilute samples. Author

N70-39725# California Univ., Berkeley Lawrence Radiation Lab. Inorganic Materials Research Div.
MOVING BOUNDARY MEASUREMENTS OF TRANSFERENCE NUMBERS
Kong-Heong Tan (M.S. Thesis) Mar. 1970 83 p refs

(Contract W-7405-eng-48)
(UCRL-19141) Avail: NTIS

The moving-boundary technique as was employed to determine the transference numbers of ammonium nitrate solutions at concentrations covering both the dilute and concentrated regimes in order to render more complete its set of transport properties. Silver nitrate was the following solution in all instances. Author

N70-39727# Iowa State Univ. of Science and Technology, Ames.
BIBLIOGRAPHY OF MASS SPECTROSCOPY LITERATURE FOR THE LAST HALF OF 1967 COMPILED BY A COMPUTER METHOD
J. Capellen, H. J. Svec, J. R. Jordan, and W. J. Watkins, comps. Jun. 1970 458 p refs
(Contract W-7405-eng-82)
(IS-2058) Avail: NTIS

The report covers the last half of 1967 and lists 4674 articles of interest to mass spectroscopists. The report consists of three sections: a bibliography section, an author index section, and a key word out of context index (KWOC Index) section. The bibliography section lists the authors, the title, and the source for each article. The Author index lists the authors' names and the reference numbers of their articles. The KWOC Index lists the key words, the reference numbers of the articles in which the key word appears, and the first 100 characters of the title. Author (NSA)

N70-39741# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
THERMODYNAMICS OF METAL CYANIDE COORDINATION. PART 9: LOG K, DELTA H(O), DELTA S(O) VALUES FOR THE Ni(2+)-, Zn(2+)-, Cd(2+)-, AND Hg(2+)-CN(-) SYSTEMS AT 10, 25, AND 40 DEG
R. M. Izatt, H. D. Johnston, D. J. Eatough, J. W. Hansen, and J. J. Christensen 7 May 1970 21 p refs
(COO-1782-2) Avail: NTIS

Log K, delta H degrees, and delta S degree values valid at zero ionic strength are summarized from previous studies for cyanide ion interaction with bivalent nickel, zinc, cadmium, and mercury at 10, 25, and 40 degrees. From the values of Delta H degrees as a function of temperature, average delta C sub P degree values are calculated. Author (NSA)

N70-39742*# Whittaker Corp., San Diego, Research and Development Div.
POLY(VINYL ETHERS) SYNTHESIS FOR FUNDAMENTAL STUDY OF VISCOELASTIC STATE Final Report
H. A. Anderson, B. J. Burreson, and W. P. Fitzgerald, Jr. Apr. 1970 28 p ref Prepared for JPL
(Contract NAS7-735)
(NASA-CR-113589) Avail: NTIS CSCL 07C

The large-scale synthesis of amorphous poly(vinyl ethers) using the aluminum hydrosulfate catalyst system in hydrocarbon solvent was demonstrated. The elastomers were synthesized from the following commercially-available vinyl ether monomers: methyl vinyl ether, ethyl vinyl ether, n-propyl vinyl ether, n-butyl vinyl ether, isobutyl vinyl ether, n-hexyl vinyl ether, phenyl vinyl ether, n-decyl vinyl ether, and n-hexadecyl vinyl ether. The lower members of the homologous polymer series were amorphous, elastomeric masses, soluble in methyl ethyl kryone, whereas the higher members tended to be insoluble. Based on several types of evidence, this solubility is attributed to increasing hydrocarbon-like character of polymer. These high molecular-weight, long side-chain systems show negligible crystallinity, and retain solubility in hydrocarbon solvent. The poly(cetyl vinyl ether) was obtained as a resilient solid material, which would appear to have potential as a molding material. This modification was obtained by facile bulk polymerization. Author

N70-39757# British Iron and Steel Research Association, London, (England).
THE DETERMINATION OF BORON IN STEEL
10 Mar. 1970 18 p refs Supersedes MG/D/586/69
(PB-191974; MG/D/414/70; MG/D/586/69) Avail: NTIS CSCL 11F

Two methods for the determination of boron in steel have been critically examined, and one is recommended for adoption as a British Standard method. In this procedure, boron is separated from a sulphuric acid solution of the sample by distillation complex with curcumin is developed in sulphuric-acetic acid solution, extracted into acetone and its absorption measured photometrically. The principal advantages of the method lie in its specificity and sensitivity. It is therefore, particularly useful for the analysis of highly-alloyed steels, and certain nickel alloys have been successfully analyzed. Author (USGRDR)

N70-39771# Nebraska Univ., Lincoln. Dept. of Physics.
COLORATION OF KCl-OH(-) ULTRAVIOLET LIGHT
Wendell G. Bradley (Ph.D. Thesis) Jul. 1970 99 p refs Supported by AEC
(COO-525-33) Avail: NTIS

The crystals are colored at temperatures between 193 K and 298 K. The F-band growth curves exhibit an early-stage coloration which reaches a maximum after a few hundred seconds and then decays. Further irradiation can produce a late-stage coloration. The early-stage coloration is interpreted as an OH(-) to F conversion resulting in many F centers which are particularly unstable due to their proximity to other OH(-) decomposition products and soon either revert back to OH(-) or form U and other centers. The decay in the F-band growth curve occurs when the rate of production of the early-stage F centers falls below their rate of bleaching. The late-stage coloration is associated primarily with a U to F conversion. Mathematical models consistent with the gross behavior of the F-band growth curves are proposed. Thermoluminescence peaks are found at -25 C, 10 C, and 45 C for a constant heating rate of 7 C/min. The entire glow curve is well-matched to the temperature rate of restoration of OH(-) centers. Author

N70-39788# British Steel Corp., London (England). Metallurgy Div.
THE DETERMINATION OF SULPHUR IN NON-METALLIC MATERIALS
R. F. Statham (Samuel Fox and Co., Ltd.) 1970 19 p ref Prepared in cooperation with Samuel Fox and Co. Ltd. Supersedes MG/DB/481/68
(PB-191973; MG/D/412/70) Avail: NTIS CSCL 11F

A critical examination of a combustion method for the determination of sulphur using nitrogen as carrier gas has been made and, from the information obtained, the method has been modified so that it can be used for the determination of the sulphur content of a wide variety of oxide type materials. The time taken for a determination varies, with the type of sample, from 5 to 30 minutes. Although the recovery of sulphur is not stoichiometric, a constant yield of approximately 95 per cent is obtained. On a routine basis, a correction factor of 1.05 can be applied, or alternatively, samples of similar material, of known sulphur content, can be used as standards and the factor calculated. As the titration is an oxidation - reduction reaction, there is no interference from any fluorien present in the sample. Author (USGRDR)

N70-39788*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE SCIENCES DIVISION
In its Space Programs Sum. No. 37-63, Vol. 3 30 Jun. 1970 p 1–22 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 07D

A base line study for the design of a near infrared multidetector

grating spectrometer and the programming required to analyze detector flight data are completed. A new method for determining SiO2 quantities in silicate glass by powder film transmission measurements in the infrared is described. High resolution mass spectrometry is used to analyze pyrolysis products from nucleic acid materials in a vacuum environment. Physics research activities center on a mathematical treatment of axially symmetric rotation of a perfect fluid and rate measurements on the alkyne ozonation mechanism. G.G.

N70-39806# Mainz Univ. (West Germany).
INSTITUTE FOR INORGANIC CHEMISTRY AND NUCLEAR CHEMISTRY Annual Report, 1968 [INSTITUT FUER ANORGANISCHE CHEMIE UND KERNCHEMIE JAHRESBERICHT, 1968]
Feb. 1970 113 p refs In GERMAN; ENGLISH summary
Sponsored by Bundesministerium fuer Bildung und Wiss.
(BNBW-FBK;70;4) Avail: AEC Depository Libraries

The report is composed of the following parts: performance of a Triga reactor and Cockcroft-Walton accelerator rapid chemical separations; decay properties short-lived neutron-rich nuclei; mass and charge distribution in fission; detection of super-heavy elements; activation analysis; and fallout studies. Author (NSA)

N70-39835# Washington State Univ., Pullman. Dept. of Chemistry.
KINETICS OF WATER EXCHANGE IN AQUOAMMINE COBALT II COMPLEXES
Patrick E. Hoggard, Harold W. Dodgen, and John P. Hunt [1970] 26 p refs Supported in part by AEC
(RLO-2040-20) Avail: NTIS

Using O-17 NMR, water exchange in paramagnetic aquo and substituted aquo metal ions was investigated to determine the effects produced by various ligands. The results of the kinetics of Co(H2O)(2+)6, Co(H2O)5(NH3)(2+), and Co(H2O)4(NH3)(2+)2 species in aqueous solutions are reported. Comparisons with other cobalt systems and with nickel are also made. Author (NSA)

N70-39854# California Univ., La Jolla. Dept. of Chemistry.
ON THE EQUILIBRIUM STRUCTURE OF SIMPLE LIQUIDS
David Chandler and John D. Weeks 24 Jun. 1970 15 p refs
(Contract N00014-67A-0109-0010- ARPA Order 125)
(AD-708041; TR-3) Avail: NTIS CSCL 7/4

It is shown that the repulsive (not merely the positive) portion of the Lennard-Jones potential quantitatively dominates the equilibrium structure of the Lennard-Jones liquid. A simple and accurate approximation for the radial distribution function at high densities is presented. Author (TAB)

N70-39857# Clarkson Coll. of Technology, Potsdam, N.Y. Chemical Engineering Dept.
CONDENSATION OF A CONDENSABLE COMPONENT FROM A MIXTURE OF GASES UPON A VERTICAL SURFACE Final Report, 1 Apr. 1961–28 Feb. 1969
3 Dec. 1969 48 p refs
(Contract AT(30-1)-2765)
(NYO-2765-3) Avail: NTIS

A theoretical and experimental study of laminar filmwise condensation on a vertical surface of a single vapor component from a mixture of stagnant gases is presented. The experimental apparatus is designed to obtain overall condensation rates and local temperature profiles in the gas phase boundary layer. Local temperature data obtained experimentally demonstrate the validity of the two major assumptions included in the model - (1) interfacial temperature is independent of distance along the condensing surface and (2) similarity of profiles which enables reduction of the partial differential transport equations to total differential equations with unique boundary conditions. Overall condensation rates predicted from the model are found to be lower than those obtained experimentally due to radial vapor flow, nonideal liquid flow and difficulties in wetting the surface. An extension of the binary-component condensation model to multicomponent vapor-gas mixtures utilizing a constant property film-reference state method with a discussion of the numerical procedure employed in obtaining solutions of the total differential equations is included. Experimental data obtained on two multicomponent systems demonstrate that the assumptions involved in the multicomponent model are no more demanding than those in the binary mixture. Author

N70-39866# Purdue Univ., Lafayette, Ind.
PROJECT SQUID Semiannual Progress Report, 1 Oct. 1969–31 Mar. 1970
I. E. Alber, R. A. Dobbins, J. B. Fenn, A. Fontijn, and J. L. Franklin 1 May 1970 77 p refs
(Contract N00014-67-A-0226-0005)
(AD-708052) Avail: NTIS CSCL 21/2

Reports of progress on 16 research programs comprising Project SQUID are presented. The research programs fall into the areas of fluid mechanics, atomic and molecular collision, combustion and chemical rate processes, and chemi-ionization and ion-molecular reactions. Author (TAB)

N70-39878# Miami Univ., Coral Gables, Fla. Dept. of Chemistry.
MECHANISMS OF REACTIONS OF OXIDIZERS Annual Report, 1 Jun. 1969–31 May 1970
A. G. Keenan 31 May 1970 7 p refs
(Contract Nonr-4008(07))
(AD-708050; AR-9) Avail: NTIS CSCL 7/2

Progress in the investigation of the synergistically catalyzed decomposition of oxidizers such as ammonium nitrate and ammonium perchlorate is summarized. Research was done in the areas of thermal analysis, rate studies, catalytic, and mechanistic studies, electrometric measurements, UV and visible spectrophotometry and computer calculations. Author (TAB)

N70-39882# Oregon State Univ., Corvallis. Dept. of Chemistry.
GEOMETRY AND INFRARED SPECTRA OF MATRIX ISOLATED RARE-EARTH HALIDES. 1: LaF3, PrF3, EuF3, AND HoF3
R. D. Wesley and C. W. De Kock [1970] 20 p refs Sponsored in part by AEC and Am. Chem. Soc.
(RLO-2097-3) Avail: NTIS

The infrared absorption spectra of lanthanum fluoride, praseodymium fluoride, europium fluoride, and holmium fluoride vapors trapped in solid argon matrices at 15 K were obtained. For LaF3, EuF3, and HoF3, the asymmetric stretching mode and the bending frequencies were observed; these molecules are assigned a planar configuration. For PrF3, the symmetric and the asymmetric stretching modes as well as the bending frequencies were observed and praseodymium fluoride is accordingly assigned a pyramidal configuration. Using a valence force field approximation, force constants were derived from the measured fundamental frequencies and the infrared inactive symmetric stretching frequency of the planar molecules have been estimated. Statistical entropies were also calculated from the vibrational data and molecular geometries and are compared with third law values. Author (NSA)

N70-39905# Politecnico di Torino (Italy). Ist. di Meccanica Applicata Aerodinamica e Gasdinamicao.
LINE RADIATION IN NONLOCAL THERMODYNAMIC EQUILIBRIUM
Massimo Germano Dec. 1969 19 p refs
(Grant EOOAR-68-0049)

(AD-706218; Scientific-7; AFOSR-70-110TR; TN-53) Avail: NTIS CSCL 7/4

In the paper, the problem of the line radiation in condition of non thermodynamic equilibrium has been treated and the results obtained have been applied to the study of the imprisonment of resonance radiation. It was found that the excited level, and by consequence the resonance radiation, decays in two ways in competition each other: one is a diffusive decay, due to the fact that the gas is generally very thick for frequencies near the center of the absorption line, and the other is an exponential decay due to the far wings of the absorption coefficient where the gas is optically thin. Author (TAB)

N70-39941*# Scientific Translation Service, Santa Barbara, Calif.
GAS ADSORPTION ON VARIOUS KINDS OF ADSORBENTS IN LOW TEMPERATURE-PRESSURE REGIMES [ADSORBTSIYA GAZOV NA ADSORBENTAKH RAZLICHNOY PRIRODY V OBLASTYAKH NIZKIKH DAVLENII I TEMPERATUR]
M. F. Fedorova Washington NASA Sep. 1970 8 p refs Transl. into ENGLISH from Akad. Nauk Belorussk. SSR, Vestio Ser. Khim. Nauk, Pt. 1, 1966 p 39–43
(Contract NASw-2035)
(NASA-TT-F-13243) Avail: NTIS CSCL 07D

The interaction of monatomic and molecular gases with various adsorbents is examined. It is established that adsorption can proceed below the adsorbate solidification point, and that there is an effective temperature regime for each gas, at which the adsorption takes place very intensely. Author

N70-40043# Stanford Univ., Calif. Dept. of Computer Science.
TOWARD AN UNDERSTANDING OF INFORMATION PROCESSES OF SCIENTIFIC INFERENCE IN THE CONTEXT OF ORGANIC CHEMISTRY
Bruce G. Buchanan, Georgia L. Sutherland, and Edward A. Feigenbaum Oct. 1969 70 p refs
(Contract ARPA SD-183)
(AD-708070; SU-AIM-99) Avail: NTIS CSCL 6/4

The program called Heuristic DENDRAL solves scientific induction problems of the following type: given the mass spectrum of an organic molecule, what is the most plausible hypothesis of organic structure that will serve to explain the given empirical data. Its problem solving power derives in large measure from the vast amount of chemical knowledge employed in controlling search and making evaluations. A brief description of the task environment and the program is given in Part 1. Recent improvements in the design of the program and the quality of its performance in the chemical task environment are noted. The acquisition of task-specific knowledge from chemist-experts, the representation of this knowledge in a form best suited to facilitate the problem solving, and the most effective deployment of this body of knowledge in restricting search and making selections were major foci of the research. Part II discusses the techniques used and problems encountered in eliciting mass spectral theory from a cooperative chemist. A sample scenario of a session of the representation of the chemical knowledge and the design of processes that utilize it effectively. The initial, rather straightforward, implementations were found to have serious defects. These are discussed. Part IV is concerned with our presently-conceived solutions to some of these problems, particularly the rigidity of processes and knowledge-structures.
Author (TAB)

N70-40077# Iowa State Univ. of Science and Technology, Ames. Rare-Earth Information Center.
REVIEWS ON RARE EARTHS. A COMPILATION OF BOOKS, CHAPTERS OF BOOKS, JOURNAL ARTICLES, REPORTS, CONFERENCE PROCEEDINGS AND BIBLIOGRAPHIES PUBLISHED FROM 1946 TO 1968
C. C. Bertrand and K. A. Gschneidner, Jr., comps. Jun. 1969 87 p refs
(Contract W-7405-eng-82)
(IS-RIC-3) Avail: NTIS

The bibliography is composed of about 500 general and specific reviews of papers on rare earths written from 1946 to 1968. However, there are a few books included that were written as early as 1912. NSA

N70-40078# Avco-Everett Research Lab., Everett, Mass.
SHOCK TUBE STUDY OF THE EFFECT OF VIBRATIONAL ENERGY OF N2 ON THE KINETICS OF THE O PLUS N2 YIELDS NO PLUS N REACTION
Kurt L. Wray, Eugene V. Feldman, and Paul F. Lewis Jun. 1970 34 p refs
(Contract F04701-69-C-0122; ARPA Order 1092)
(AD-707839; AERL-RR-342; SAMSO-TR-70-149) Avail: NTIS CSCL 7/4

The kinetics of the reaction O + N2 + 3.3 eV yields NO + N were investigated under conditions where the vibrational temperature of the nitrogen was less than the translational temperature. The formation of NO behind incident shock waves in dilute O3-N2 mixtures was studied over the temperature range 3100-6400K with initial pressures of 2 to 25 torr. In the shock front O3 yields O + O2 and the reaction of the O with N2 is then rate-limiting, followed by the fast reaction N + O2 yields NO + O. The NO was monitored in emission at 5.3 microns and the initial slopes were compared to theoretical calculations which included vibrational relaxation processes. The radiation rose linearly from the shock front with no incubation in accord with the theoretical calculations employing only translational energy to determine the fraction of collisions whose energy was above the endothermicity of reaction. Author (TAB)

N70-40080 Rice Univ., Houston, Tex.
TRANSLATIONAL ENERGIES OF PRODUCTS OF MASS SPECTROMETRIC REACTIONS
Max Allen Haney (Ph.D. Thesis) 1969 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-19295

The translational energies of unimolecular and bimolecular reactions of ions in the mass spectrometer were studied. The unimolecular reactions were fragmentations of polyatomic molecules with excess energies at the appearance potentials. The translational energies of a series of dissociations were measured at the appearance potentials of the fragment ions and an expression of their relationship was derived. This relationship was applied to the determination of excess energies in appearance potentials of fragments from several oxygen-containing organic molecules. The heats of formation of HCO, CH3CO, CH3O, C2H5O, HCO2, and the corresponding positive ions were determined from this data. The method is shown to be competitive with standard kinetics methods for determining heats of formation of radicals. Dissert. Abstr.

N70-40116# California Univ., Los Angeles. Dept. of Chemistry.
OPTICAL DETERMINATION OF THE POLARIZATION OF THE MICROWAVE ZERO-FIELD TRANSITIONS
M. A. El-Sayed and O. F. Kalman Jun. 1970 37 p refs
Submitted for publication *Its* Contrib. No. 2591
(Contract N00014-69-A-0200-4012)
(AD-708054; TR-5) Avail: NTIS CSCL 7/4

An optical method is described by which the polarization characteristics, and thus the symmetry assignment, of the zero-field magnetic transitions can be determined in zero-field. In this method, the guest molecule being studied is dissolved in a single crystal of known structure. The oriented mixed crystal is placed inside a microwave helix in a position where the magnetic field along the helical axis is maximum, with one of the crystal axes being parallel

to the helix axes. A relationship is derived which relates the changes in the phosphorescence intensity of the sample to the power of the microwave radiation that induces the magnetic transitions between the zero-field levels of the lowest triplet state. Author (TAB)

N70-40127# Iowa State Univ. of Science and Technology, Ames.
SEPARATION OF THE HEAVIER RARE EARTHS BY FRACTIONAL SOLVENT EXTRACTION
Norman Earl Thomas (M.S. Thesis) Feb. 1970 63 p refs
(Contract W-7405-eng-82)
(IS-T-370) Avail: NTIS

Equilibrium data were obtained for the systems TmCl3 – 5M HCl – H2O – 1M D2EHPA (in Amsco odorless mineral spirits) and YbCl3 – TmCl3 – 5M HCl – H2O – 1M D2EHPA – Amsco. The separation factor for YbCl3 with respect to TmCl3 was found to be essentially constant with an arithmetic average value of 3.22. An empirical correlation was developed for predicting the total distribution coefficients for the binary lanthanide system YbCl3 – TmCl3 – 5M HCl – H2O – 1M D2EHPA – Amsco. A digital computer program was written, using the experimental distribution function and the experimental value of the separation factor, to predict the operating conditions necessary for the fractional extraction of a 90% YbCl3 – 10% TmCl3 – 5M HHCl feed into a 98% YbCl3 extract product at 90% YbCl3 recovery. A comparison of the results predicted by the computer technique and the results obtained experimentally by a laboratory simulation of the extraction process indicated that the technique was valid. Author (NSA)

N70-40209# Boston Coll., Chestnut Hill, Mass. Dept. of Chemistry.
DISSOCIATIVE PROBABILITIES FOR SQUARE WELL OSCILLATORS
W. G. Valance and J. L. Lin May 1970 15 p refs
(Contract N00014-69-A-0453)
(AD-707422; FRK-104) Avail: NTIS CSCL 7/4

Bound to continuum transition probability for a square well oscillator under a collinear collision with an inert gas atom is derived using the first order time dependent perturbation theory. The continuum wave function of the oscillator is quantized by the method of box normalization. The theory is applied to the system He + H2 to compute the dissociative probability as a function of total energy. This result is then discussed in relation to the dissociation of diatomic molecules. Author (TAB)

N70-40210# George Washington Univ., Washington, D.C. Dept. of Chemistry.
THE PYROLYSIS OF DIFLUORAMINE
Joseph B. Levy and Vinod R. Desai 1 Jun. 1970 28 p refs
(Contract N00014-67-C-0344)
(AD-707428; SL-100) Avail: NTIS CSCL 7/4

The pyrolysis of difluoramine has been investigated over the temperature range 275-351C. Evidence is presented that in Teflon and Monel vessels the reaction is heterogeneous while in Pyrex Bulbs it is not. The reaction in the Pyrex bulb corresponded to a stoichiometry of 4HNF2 to 4HF + N2 + N2F4. The reaction kinetics could only be interpreted in terms of inhibition by a product. The kinetics were analyzed and an activation energy of about 43 kcal./mole was deduced. Possible reaction mechanisms are discussed. Author (TAB)

N70-40211# Air Force Systems Command, Edwards AFB, Calif. Air Force Rocket Propulsion Lab.
THE INFRARED SPECTRA OF METHOXYAMINE AND METHOXYAMMONIUM ION Technical Report, Aug. 1968 – Oct. 1969
H. M. Nelson May 1970 34 p refs
(AD-707499; AFRPL-TR-70-3) Avail: NTIS CSCL 7/4

The infrared spectra of CH3ONH2, CH3OND2, CH3ONH3(+)Cl(-) and CH3OND3(+)Cl(-) were obtained in the region 4000 - 40)CM5 WITH THE SAMPLES IN THE FORM OF THIN CRYSTALLINE FILMS AT LIQUID NITROGEN TEMPERATURE. With the exception of the CH3 and NH3(+) torsions all the fundamentals for methoxyamine and methoxyammonium ion have been observed and assigned. Davies and Spiers assignments for CH3ONH2 have been revised in part and the NH2 twist and wag located. The assignments for CH3ONH3(+) ion are readily correlated with those for CH3ONH2 and for both species the assignments for the A vibrations are consistent with the product rule. Author (TAB)

N70-40228# California Univ., San Diego. Dept. of Chemistry.
ON THE EQUILIBRIUM STRUCTURE AND THERMODYNAMICS OF SIMPLE LIQUIDS
John D. Weeks, David Chandler, and Hans C. Anderson (Stanford Univ., Calif.) 9 Jul. 1970 52 p refs Prepared in cooperation with Stanford Univ.
(Contract N00014-67-A-0109-0010; ARPA Order-125)
(AD-708676; TR-4) Avail: NTIS CSCL 7/4

The equilibrium structure and thermodynamics of a simple liquid is discussed. The particular system considered in our calculations is the Lennard-Jones liquid in which the intermolecular interaction is the pairwise additive 6-12 potential. The potential is separated into two parts, a reference part containing all the repulsive forces and a perturbation containing all the attractive forces. (This separation is distinctly different from the often-used separation of the potential into positive and negative parts.) It was found that the effects of the two parts of the potential on the structure of the liquid are most easily discussed in terms of the structure factor (or equivalently, the Fourier transform of the pair-correlation function) rather than the pair-correlation function itself. On the basis of the results a very simple prescription is given for calculating the radial distribution function of a simple liquid at high densities which is more accurate than those obtained by any previously reported theory. Author (TAB)

N70-40245# Tetra Tech., Inc., Pasadena, Calif.
STUDIES OF EXCITED HYDROGEN IN RELATION TO ADVANCED PROPULSION Interim Scientific Report, 15 Mar. 1969 – 15 Mar. 1970
John M. Flournoy May 1970 17 p refs
(Contract F44620-69-C-0080)
(AD-708186; TT-TC-155-1; AFOSR-70-1429TR) Avail: NTIS CSCL 7/4

A low pressure stream of hydrogen containing several percent of the molecules in excited vibrational states was produced by allowing discharge-produced H-atoms to combine on a bare Pyrex surface. Atoms were detected by titration with NO and by means of a catalytic calorimetric probe. Excited hydrogen was monitored by observing infrared emission from HCN which is excited by collisions with the excited hydrogen molecules. Surface de-activation and reactions of excited hydrogen with other molecules are being studied. Author (TAB)

N70-40255# Notre Dame Univ., Ind. College of Engineering.
DILUTE SOLUTION PROPERTIES OF DRAG REDUCING POLYMERS
N. D. Sylvester and J. S. Tyler May 1970 36 p refs
(Contract N00014-68-C-0152; Proj. Themis)
(AD-708688; THEMIS-UND-70-8) Avail: NTIS CSCL 7/4

Experimental data on the dilute solution viscosity behavior of two effective drag reducing polymers (polyethylene oxide-Polyox and Separan - a partially hydrolyzed polyacrylamide) in various solvents (distilled water, salt water and simulated sea water) is presented and discussed. The unusual viscosity behavior observed

for both polymers in the simulated sea water for concentrations less than thirty parts per million is explained by postulating an interchain ionic bonding effect for the Separan solutions and a ion-dipole, salt-polyether complex formation in the Polyox solutions. Tentative conclusions concerning the effectiveness of the polymers as drag reducers in the solvents and concentrations tested are presented. Author (TAB)

N70-40295# Michigan State Univ., East Lansing. Dept. of Chemistry.
VIBRATIONAL SPECTRA OF SIMPLE MOLECULAR CRYSTALS
George E. Leroi Jun. 1970 43 p refs Presented at the Natl. Meeting of the Am. Crystallographic Assoc., New Orleans, 2 Mar. 1970 Submitted for publication
(Contract N00014-68-A-0109-0004)
(AD-708440; TR-7(12)) Avail: NTIS CSCL 7/4

The objectives and methods for studying the Raman and infrared spectra of simple molecular crystals are described. Recent experimental results from this laboratory are reviewed, and compared with calculations based on model potentials for the intermolecular forces. The torsional vibration of ethane is also discussed briefly. Author (TAB)

N70-40346# Lockheed Missiles and Space Co., Palo Alto, Calif.
STUDY OF THE FUSION OF METAL PARTICLES DURING COMBUSTION OF METALLIZED BALLISTIC COMPOSITES AND A FUEL-OXIDIZER MIXTURE
P. F. Pokhil et al. [1970] 15 p refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (USSR), no. 1, 1970 p 80–92
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

In order to produce a representation of the combustion mechanism of aluminum particles, the size, shape, and state of the particle surfaces before and after combustion of the ballistic composite at different pressures was investigated. The smoke and metal particles deposited on the bottom of a glass cuvette placed in a constant pressure cylinder were collected after combustion of the composite and were studied visually under a microscope. The conglomeration of a considerable quantity of aluminum particles with soot occurs on the composite surface with the formation of networks, whose separate aggregates, after their rupture, are entrained by the gaseous combustion products. Experiments were conducted to study the merger and to clarify the question of the influence of the percentage of admixture and initial size of the metal particles on the merger process during combustion of a fuel-oxidizer-metal composite. The influence of the nature of the oxidizer, as well as the physicochemical properties of the fuel, on the aluminum particle merger process was also studied experimentally. Author

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N70-39002# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC PREDICTIONS, JULY 1970
May 1970 4 p
(RRC-B166) Avail: NTIS

Graphs of predicted median foF2 values and predicted median MUF(4000)F2 values are presented, along with a nomogram for transforming F2-zero-MUF and F2-4000-MUF to equivalent maximum usable frequencies at intermediate transmission distances. Author

N70-39003# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC PREDICTIONS, AUGUST 1970
May 1970 4 p
(RRC-B167) Avail: NTIS

Graphs of predicted median foF2 values and predicted median MUF(4000)F2 values are presented, along with a nomogram for transforming F2-zero-MUF and F2-4000-MUF to equivalent maximum usable frequencies at intermediate transmission distances. Author

N70-39011# Adelaide Univ. (Australia). Dept. of Physics.
A CAUSE OF DISPERSION IN IONOSPHERIC DRIFT RECORDS
D. G. Felgate and M. G. Golley Aug. 1970 11 p refs
(ADP-92) Avail: NTIS

The three receiver dispersion analysis is applied to ionospheric drift records in which the velocity varies with time. It is shown that these variations can produce an apparent positive dispersion. Dispersion is here defined as any variation of velocity for each frequency of a sinusoidal waveform with a particular wavelength and velocity across the receiving system. Author

N70-39017+ British Broadcasting Corp., Kingswood (England). Research Dept.
A PCM SOUND-IN-SYNCS SYSTEM FOR OUTSIDE BROADCASTS
C. J. Dalton Aug. 1970 15 p refs
(Rept-1970/28) Avail: NTIS

A ruggedised version of the Sound-in-Syncs system is described which, in exchange for a reduction of audio bandwidth and signal-to-noise ratio, provides sound and vision circuits over links which were degraded to an extent where they would normally be regarded as unusable. Field trials of the system, using experimental equipment, were conducted by television outside broadcasts under service conditions. Author

N70-39021# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FROM SALISBURY, SOUTH AUSTRALIA, JULY 1969
Apr. 1970 28 p refs
(SAD-1969/7(S)) Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for July 1969. Author

N70-39075 Washington Univ., Seattle.
NEAR ZONE ELF AND VLF PULSE PROPAGATION IN THE EARTH IONOSPHERE WAVEGUIDE
Dennison Ross Bernotski (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-18273

The propagation of ELF and VLF pulses to distances less than 200 km are studied with a parallel plate waveguide used to simulate a flat earth-ionosphere waveguide. Finitely conducting boundaries are assumed. Both the vertical and horizontal electric dipole sources are studied. The mode or residue series is studied in detail as a function of frequency. The mode numbers are found from the transcendental mode equation by using Newton's iteration procedures. The waveguide is excited by a Gaussian sinusoid pulse

and the harmonic time dependent solution is used as a transfer function. Numerical inversion integrals are used to find the vertical electric field pulse at various distances from the source and heights above the ground for both the vertical electric and the horizontal electric dipole sources. Dissert. Abstr.

N70-39077*# General Electric Co., Philadelphia, Pa.
LABORATORY MODEL HIGH RESOLUTION TELEVISION CAMERA Final Report
A. B. Schechner 20 May 1970 88 p
(Contract NAS9-8887)
(NASA-CR-108576; DOC-70SD4232) Avail: NTIS CSCL 17B

The initial evaluation of the high resolution television camera system with the selenium-doped antimony trisulfate photoconductor vidicon has shown encouraging resolution and signal-to-noise performance. This data has been taken on-axis with a high contrast scene and fixed illumination condition. The camera operating parameters were a one second frame time, 5500 line scan, and 12 MHz bandwidth. Proposed applications for this system indicate the requirement for operating at a slower frame rate reducing the electronics bandwidth, and viewing low contrast scenes at a varying illumination level. This indicates the desirability of a measurement program to obtain further useful performance data. Author

N70-39127 ITT Research Inst., Chicago, Ill.
A METHOD OF AVERAGE FREQUENCY MEASUREMENT
Walter Stanley Ciciora (Ph.D. Thesis) 1969 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-18613

The analysis of a generalized two channel balanced frequency discriminator excited by a narrow process is reviewed. Comparison of the result of this analysis with the definition of the average frequency of a power spectral density suggests a new method of measuring the average frequency of a power spectral density. A priori assumptions regarding the shape of the power spectral density of the random process are not required. In contrast to much of the previous work in this area, the power spectral density shape need not be symmetric about its average frequency. No restrictions on the nature of the probability density distribution of the random process is required in proving that the new device measures the average frequency of the random process. The new device, the average voltage output is linearly related to the difference between the average frequency discriminator. For this device, the average voltage output is linearly related to the difference between the average frequency of the power spectral density at the input and the reference frequency of the device. Improved performance results from inserting the specialized frequency discriminator into a frequency tracking loop. Dissert. Abstr.

N70-39275# Mississippi State Univ., State College. Dept. of Physics.
ELECTROMAGNETIC FIELD PENETRATION OF WIRE SCREENS Final Report
H. Val McAdams, Jr. Jan. 1970 62 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(SC-CR-69-3309) Avail: NTIS

General integral equations for currents in an arbitrary thin wire structure are developed and a numerical method is presented by which the exact form of the current distribution, although discrete, may be determined. Numerical techniques for solution of the integral equations for an infinite parallel wire array and an infinite wire mesh are shown. A technique is outlined for determining the fields around a wire structure, which takes advantage of the discrete form in which the currents are calculated. Author

N70-39307*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHASED ARRAY ANTENNAS FOR APPLICATIONS ON SPACECRAFT
A. Kampinsky and W. H. Kummer (Hughes Aircraft Co., Culver City, Calif.) Jul. 1970 39 p refs Submitted for publication
(NASA-TM-X-65325; X-110-70-282) Avail: NTIS CSCL 09E

Phased array antenna systems, now operating on spacecraft, are reviewed so as to reveal their basic techniques of beam formation, steering and receive/transmit (transponder) functions. Laboratory developmental antennas, designed for ultimate spacecraft flight qualification, are assessed in terms of the needs of communications, earth resources instrumentation, and area surveillance programs. Author

N70-39309*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELECOMMUNICATIONS CAPABILITIES OF THE GSFC MARK 1 TRACKING AND DATA RELAY SATELLITE
P. J. Heffernan Oct. 1970 26 p refs Presented at the 1970 Intern. Telemetering Conf. Submitted for publication
(NASA-TM-X-65327; X-751-70-308) Avail: NTIS CSCL 17B

A spacecraft concept for the NASA tracking and data relay satellite mission is described. The proposed design, based on the use of current space-proven technology and compatible with existing launch vehicle constraints, provides telecommunications support to earth-orbiting spacecraft at VHF, S-, X- and K-Band frequencies. A summary is given of key Mark 1 RF parameters including transmit effective radiated power and receiving system gain-to-temperature ratio at the several frequencies of operation. On the basis of the RF parameters postulated, data are presented on system signaling rates and performance thresholds. The results, presented as a family of parametric nomographs, provide a concise summary of the telecommunications capabilities of the Mark 1 TDRS spacecraft design. Author

N70-39326# National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
Mar. 1970 28 p
(RRC-A177-PT-2) Avail: NTIS

Tables of predicted and observed sunspot numbers are presented for February, 1970, as well as 100 MHz solar flux, optical observations of solar flares, solar flare effects (chrochets), magnetic storms, and ionospheric effects of solar flares. Diagrams of sudden ionospheric disturbances are also included. J.M.

N70-39336# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF DISTORTION OF DIVERS' SPEECH USING POWER SPECTRAL ESTIMATES BASED ON THE FAST FOURIER TRANSFORM
William Howard Bond (M.S. Thesis) and James Michael Myatt (M.S. Thesis) Jun. 1969 94 p refs
(AD-707729) Avail: NTIS CSCL 17/2

The problem of distortion in underwater communications peculiar to free divers and techniques for analysis of speech wave forms are discussed. The fast Fourier transform algorithm, selected to analyze shifts in formant frequencies due to restricted oral cavities, high ambient pressures, and forced speech is discussed. The fast Fourier transform is used to analyze a vowel sound and show that the expected shifts do occur. Recommendations are made for extending the techniques to all non-noise like sounds and breathing mixtures other than compressed air. Author (TAB)

N70-39373# Naval Postgraduate School, Monterey, Calif.
NARROWBAND AND WIDEBAND AMBIGUITY FUNCTIONS FOR SELECTED BARKER BINARY PHASE CODES
Jon Phillip Kjellander (M.S. Thesis) Oct. 1969 57 p refs
(AD-707733) Avail: NTIS CSCL 9/4

The Barker binary phase codes have the interesting property that the magnitude of the range sidelobes never exceeds 1/N.

where N is the code length. This thesis presents ambiguity functions for certain selected Barker binary phase codes in the form of computer-drawn three-dimensional projections. Both the narrowband and wideband cases are taken into consideration. Author (TAB)

N70-39413*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SRT
In its Res. and Advanced Develop. 31 Aug. 1970 p 5–30 refs (See N70-39411 22-34)
Avail: NTIS CSCL 17B

Techniques for developing low-cost multiple-access satellite telephone communications systems for use in remote areas of the world are considered. A system would be comprised of one satellite, or part thereof, and a large number of ground stations, each with one telephone circuit to provide highly reliable speech communications with high intelligibility and fair-to-good quality. Work is directed toward determining which modulation and multiple-access techniques are most suitable for the envisioned system, and the evaluation of system cost in terms of required satellite and ground station qualities. Author

N70-39521# Illinois Univ., Urbana. Coordinated Science Lab.
FLOW RELIABILITY OF COMMUNICATION NET
Wataru Mayeda Jun. 1970 18 p refs
(Contract DAAB07-67-C-0199)
(AD-707876; R-476; UILU-eng-70-221) Avail: NTIS CSCL 17/2

In a communication net, each edge has a capacity called an edge capacity and as long as a given flow is not larger than the terminal capacity the flow can be transmitted via the net. When edges have non-zero probabilities of failure to handle flow, in addition to edge capacities, then it is not always possible to transmit a flow via a net all the time. However there is a high probability that a portion of flow can be transmitted. To indicate how much of a flow can be transmitted under such circumstances, a flow reliability is introduced. Then several ways of increasing the flow reliability of a given communication net such as reduction of probabilities of failure of edges, reduction of a given flow, and modifying a given net is discussed. Author (TAB)

N70-39538# Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
TRANMISSION INTERFERENCE BY UNDESIRABLE REFLECTIONS IN ADCOCK AND DOPPLER DIRECTION FINDER [UEBERTRAGUNGSSTOERUNGEN DURCH UNERWUENSCHTE REFLEXIONEN BEIM ADCOCK- UND DOPPLERPEILER]
Hans A. Fiel (Ph.D. Thesis) 14 Apr. 1969 109 p refs In GERMAN
Avail: NTIS

Reflections introduce amplitude and phase distortions in wire- and wireless communications transmission cause error signals in direction finders. The use of large base systems improves results, but strong reflections in an unfavorable terrain and at certain angles of incidence still produce errors of about 5 deg. in the Adcock and Doppler direction finder, even at a base n length six times larger than the wave length. Suitable modulation of the receiver, wobbling, or impulse keying make recognition and seperation of the main signal from introducing noise signals possible. Transl. by G.G.

N70-39548# Illinois Univ., Urbana. Coordinated Science Lab.
L-STEP MAJORITY LOGIC DECODING
Robert T. Chien and Spencer W. Ng Jun. 1970 45 p refs
(Contracts DAAB07-67-C-0199; F30602-70-C-0014)
(AD-707877; R-477; UILU-eng-70-222) Avail: NTIS CSCL 9/4

In the search for multiple-error-correcting codes which can be easily and rapidly decoded, some coding theorists have turned their attentions to threshold (majority logic) decoding. Much work has been done in this area recently, and quite a few classes of new codes suitable for threshold decoding have been developed. The main desirable feature of majority logic decoding is that it can be very simply implemented. Furthermore majority decoding can also automatically correct many more patterns of errors other than those guaranteed by the decoding schemes without any additional equipment. This paper is a survey of the L-step majority decoding. TAB

N70-39560# National Bureau of Standards, Boulder, Colo.
FIELD STRENGTH ABOVE 1 GHz: MEASUREMENT PROCEDURES FOR STANDARD ANTENNAS
Ronald R. Bowman *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 75–84 refs (See N70-39551 22-09)
Avail: SOD $5.50

To calibrate antennas for state-of-the-art strength measurements above 1 GHz, standard antennas are needed that have gain values known to within + or – 0.1 dB. Absolute gain measurements for horn antennas by the two-antenna method are discussed. The two-antenna method is considered to be essentially an insertion-loss measurement, and this concept is used to derive a working formula that is suitable for high-accuracy gain measurements. The two most intractable problems, insufficient antenna separation and multipath interference, are discussed in detail. Some experimental details are included that have previously been overlooked or inadequately discussed, and it is concluded that previous error estimates of less than + or – 0.1 dB for horn-gain measurements are somewhat optimistic. To facilitate the design and evaluation of high-accuracy gain measurements, some simple terms, concepts, and formulas are provided that are useful in analyzing multipath interference. Author

N70-39578# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
MISMATCH ERRORS IN MICROWAVE PHASE SHIFT MEASUREMENTS
G. E. Schafer *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 249–254 refs (See N70-39551 22-09)
Avail: SOD $5.50

A formal scattering matrix analysis is used to derive expressions for phase relationships of the wave amplitudes for a two-arm wave guide junction in a system with reflections. The results of the analysis are used to evaluate mismatch error for different choices of reference waves. Two techniques of variation of phase shift measurements are analyzed. Graphs of the limits of mismatch error in a commonly used method of measurement are presented. Author

N70-39621# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A THEORETICAL AND EXPERIMENTAL STUDY OF RADAR MULTIPATH EFFECTS OVER THE SEA
Vernon W. Pidgeon Oct. 1969 44 p refs
(Contract NOw-62-0604-C)
(AD-707793; APL-TG-1089) Avail: NTIS CSCL 17/9

Whenever a radar signal is used against a low-altitude target, signal strength may fade because signal reflections from the surface of the earth interfere with the direct signal from the target. This fading can cause serious missile-guidance problems. A digital computer program has been developed that computes the effects of radar multipaths over the sea, and an experimental program has been conducted in which multipath effects at L- and S-bands have been measured. With certain notable exceptions, the results of the theoretical and experimental programs agree very closely. Modifications to the computer program that are suggested by the experimental results are primarily to the computations in the vicinity of the radar horizon, where signal strength should be

computed by using a fall-off rate (in signal strength per given range) that is proportional to the cube root of the radar frequency. Values of the rough-sea reflection coefficient have been verified for grazing angles down to less than one milliradian. Author (TAB)

N70-39731# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR JUNE 1969 FROM SALISBURY, SOUTH AUSTRALIA
Mar. 1970 28 p
(WRE-SAD-1969/6(S)) Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for June 1969. Author

N70-39789*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TELECOMMUNICATIONS DIVISION
In its Space Programs Sum. No. 37-63, Vol. 3 30 Jun. 1970 p 23–79 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 17B

Finite sets and generalization to compact metric spaces were used to study the relationship between games of search and optimum storage of information. A mathematical model was developed for a digital phase-locked loop to update the timing of the local oscillator in a single channel command system. The interplex modulation system for 2-channel telemetry was extended to multichannel telemetry in the development of an unified 4-channel telemetry system for space missions. Also derived were good sub-optimum and optimum decision rules for a deep space telemetry communication scheme. Spacecraft antenna research centered on the performance of a conical antenna, voltage breakdown in monopole antennas at S-band, and radio frequency loss characteristics of reflector surface materials. Telecommunications system studies related to communications between satellites as well as to satellite tracking and signal receiving equipment performance. G.G.

N70-39801# Joint Publications Research Service, Washington, D.C.
MICROWAVE COMMUNICATION
24 Aug. 1970 16 p refs Transl. into ENGLISH from 4th Colloq. on Microwave Commun. (Budapest), 21-24 Apr. 1970
(JPRS-51225) Avail: NTIS

CONTENTS:

1. ORBITA TELEVISION DISTRIBUTION SYSTEM L. Ya. Kantor p 1–5 refs (See N70-39802 22-07)

2. PASSIVE RELAYS FOR RADIO-RELAY LINKS G. Z. Ayzenberg et al p 6–14 (See N70-39803 22-07)

N70-39802# Joint Publications Research Service, Washington, D.C.
ORBITA TELEVISION DISTRIBUTION SYSTEM
L. Ya. Kantor *In its* Microwave Commun. 24 Aug. 1970 p 1–5 refs (See N70-39801 22-07)
Avail: NTIS

The operation of the Orbita-2 communication network is described. The stations of the network can receive both black and white and color television, newspaper photocopies, and radio programs, and can act as a relay for telegraphic signals. The various components of the system are discussed. R.B.

N70-39803# Joint Publications Research Service, Washington, D.C.
PASSIVE RELAYS FOR RADIO-RELAY LINKS
G. Z. Ayzenberg et al *In its* Microwave Commun. 24 Aug. 1970 p 6–14 (See N70-39801 22-07)
Avail: NTIS

A passive relay device, consisting of a metallic surface opaque to electromagnetic waves and located perpendicular to the direction of wave propagation from two points, is described. By using barrier plates whose upper and lower edges coincide with the boundaries of some Fresnel zone, the plate area of such relays can be increased significantly without increasing the cost of the system. Examples are given for various applications of such devices. R.B.

N70-39826*# Scientific Translation Service, Santa Barbara, Calif.
THE TELECOMMUNICATONS PROGRAM FOR SATELLITE SYMPHONY [LE PROGRAMME DE TELECOMMUNICATIONS FOR SATELLITE SYMPHONIE]
J. P. Houssin Washington NASA Sep. 1970 13 p Transl. into ENGLISH from L'Echo des Rech. (France), no. 58, Oct. 1969 p 4–10
(Contract NASw-2035)
(NASA-TT-F-13231) Avail: NTIS CSCL 17B

The German Olympia Satellite and French Saros satellite programs were merged into a single symphony satellite project in 1967. Program organization, history, technical specifications, design problems and ground installations are described. Author

N70-39831# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOTION PICTURE AND TELEVISION ENGINEERING: SELECTED ARTICLES
I. K. Malakov et al 27 Feb. 1970 67 p refs Transl. into ENGLISH from Tekhn. Kino Televideniya (Moscow), v. 11, no. 10, 1967 p 30–50, 71–72
(AD-704840; FTD-MT-24-371-69) Avail: NTIS CSCL 17/2

Contents: The development of television transmitting (camera) tubes in the USSR; Domestic television receiving tubes (picture tubes); Television camera for the All-Union Television Center; The operation of the LI-415 vidicon; and Remodeling the electrical circuit of the Admira-16 movie camera. TAB

N70-39863*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CALCULATION OF ELECTROMAGNETIC FIELDS BY THE KIRCHHOFF-KOTTLER METHOD
Richard F. Schmidt May 1970 49 p refs
(NASA-TM-X-65340; X-525-70-293) Avail: NTIS CSCL 20N

Implications of the Kirchhoff–Kottler formulation for discontinuous surface distributions are discussed. The intrinsic impedance of free space is recovered from the equations for the electric and magnetic fields, and the gain dependence of the antenna on frequency and geometry is identified. The frequency dependence of each integral is tabulated, and each is associated with a physical quantity on the reflecting surface. It is shown that the Kottler contour integral vanishes for closed surfaces, independent of field values on the boundary. The behavior of the gradient of the solution to the wave equation is examined in a local context on the antenna surface to illustrate that charge distribution can give rise to transverse field components in the intermediate near field region. It is shown that the Kirchhoff–Kottler formulation inherently satisfies the radiation conditions and vanishes the radial fields of scattering surfaces in the limit as the observer recedes to infinity. The Kottler contour integral can be evolved without any appeal to physical intuition, for the case of discontinuous illumination distributions, via the dyadic Green's function. Author

N70-39961# Academy of Sciences (USSR), Moscow.
DATA TRANSMISSION SYSTEMS, SECTION 4. Conference Proceedings
1969 197 p refs In RUSSIAN 4th Conf. on Theory of Inform. Transmission and Coding, Tashkent, 29 Sep.–4 Oct. 1969 Prepared by Sci. Soviet on Complex Probl. of Cybernetics and Inst.

of Inform. Transmission Probl. of Acad. Sci USSR, Cybernetics Inst. and Computer Center of Acad. Sci. Uzbek SSR, and Sci. and Tech. Soc. of Radio Eng. and Telecommun. imeni A. S. Popov
Avail: NTIS

Papers are presented on digital data transmission and reception, signal encoding, error analysis, noise suppresion, telephony, signal redundancy, circuit reliability, and transmission efficiency. For individual titles see N70-39952 to N70-39984.

N70-39952# Academy of Sciences (USSR), Moscow.
ON SELECTING OPTIMUM RECEPTION THRESHOLDS FOR CHARACTER STORAGE IN A TERNARY CHANNEL
Ya. Kh. Adzhi-Veli and T. A. Valiev *In its* Data Transmission Systems, Sect. 4 1969 p 3–10 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A character storage method for digital transmission with symmetric code noise is examined in terms of an analytical distribution of optimum discrete reception thresholds. The error distribution adheres to a binomial principle. A model of the ternary channel is described by channel matrices, and a flow chart depicts the computer algorithm used to statistically model data transmission with character storage. Transl. by E.C.

N70-39953# Academy of Sciences (USSR), Moscow.
AN APPROACH TO ANALYSIS OF DATA TRANSMISSION SYSTEMS
A. A. Amosov and N. A. Aleksandrov *In its* Data Transmission Systems, Sect. 4 1969 p 11–18 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A data transmission system with additive noise in a binary channel is examined, assuming an autonomous probability automaton with one synchronized input symbol. A representation for a random stationary source in a probability automaton was formulated in a related study. Input units of finite length from accurately received blocks, and blocks with undetected and detected errors of various origin are considered as block indicators. It is assumed that each unit is characterized by a block located at the end of the input and that their number is finite. Transl. by E.C.

N70-39954# Academy of Sciences (USSR), Moscow.
TELEMECHANIC TRANSMISSION AND RECEPTION SYSTEM USING INTERFERENCE-SHIELDING CODES
L. A. Baranov, E. I. Galynker, V. A. Garmash, and V. E. Khazatskiy *In its* Data Transmission Systems, Sect. 4 1969 p 19–26 In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The use of linear binary codes for detecting or correcting errors in telemechanical equipment is discussed. A coding and decoding unit using Hamming codes is described, and a transmission system of four-bit binary code with time distributed signal elements is constructed to investigate a non-redundant coding system. Results show that interference to the receiving unit is not significant when Hamming codes or redundancy are used. When using other linear codes with telemechanical equipment, only the counter-distributor circuit must be adjusted. Transl. by E.C.

N70-39955# Academy of Sciences (USSR), Moscow.
OPTIMIZING DATA TRANSMISSION IN A SINGLE-CHANNEL COMMUNICATION SYSTEM
V. A. Bulgakov, I. N. Kuznetsov, and V. G. Morozov *In its* Data Transmission Systems, Sect. 4 1969 p 30–35 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A single-channel communication system with several outstations was investigated, and an algorithm for monitoring data transmission moments is presented. The algorithm aids in optimizing channel capacity and assessing system effectiveness. Transl. by E.C.

N70-39956# Academy of Sciences (USSR), Moscow.
ERROR CHARACTERISTICS FOR DIGITAL DATA TRANSMISSION USING ELECTRIC POWER TRANSMISSION LINES
L. A. Sizova *In its* Data Transmission Systems, Sect. 4 1969 p 36–45 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Digital data transmission errors were investigated for three high frequency channels using electric power transmission lines. Channel terminals were at distances of 32.5, 33, and 50 kilometers, and power levels were 110, 110, and 220 watts. An error burst analyzer, using a loop, measured errors at 600 and 1200 bands. Point test signals were used. Tests conformed to normal operating conditions for ten minute periods at various times during late spring and summer. Results of the error analysis are discussed. Transl. by E.C.

N70-39957# Academy of Sciences (USSR), Moscow.
ON SELECTING CODE COMBINATION LENGTH TO SUPPORT ERROR DECORRELATION DURING CHARACTER STORAGE IN STANDARD TELEPHONE CHANNELS
T. A. Valiev and I. Iskandarov *In its* Data Transmission Systems, Sect.4 1969 p 46–52 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Removal of accumulated characters at an adequate coding distance for error decorrelation is examined on the basis of real time operating conditions at the start of a digital data transmission. A data storage system was modeled with real time error recording. Error probability was evaluated to determine the effectiveness of data storage. Results show that a coding distance length of 500 to 3000 characters assures feasible error decorrelation and efficient data storage for various channels. Transl. by E.C.

N70-39958# Academy of Sciences (USSR), Moscow.
ON THE PERMANENCE AND INDEPENDENCE OF PROBABLE ERRORS WITHIN BURSTS IN STANDARD TELEPHONE LINES
T. A. Valiev, M. Z. Yakubova, and Sh. T. Yanyshev *In its* Data Transmission Systems, Sect. 4 1969 p 53–57 In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A hypothesis is investigated on the duration of the mathematically anticipated error total within an error burst. Statistical data are evaluated from digital transmission tests on real time telephone channels. Transl. by E.C.

N70-39959# Academy of Sciences (USSR), Moscow.
EVALUATION OF THE INTERFERENCE REJECTION OF A METHOD FOR COMPRESSION OF TELEMETRY DATA DURING FLUCTUATING INTERFERENCE
L. S. Basileva *In its* Data Transmission Systems, Sect. 4 1969 p 58–62 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A statistical coding method using multiple sources is assessed. The method aids in raising the efficiency and noise reduction of telemetry data transmissions during fluctuating interference. Transl. by E.C.

N70-39960# Academy of Sciences (USSR), Moscow.
SYNCHRONIZATION OF COMMUNICATIONS DURING DATA TRANSMISSION USING CONVOLUTED CODES

E. V. Voronov and I. A. Novikov *In its* Data Transmission Systems, Sect. 4 1969 p 63–68 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Sequential and parallel transmission of synchronized message signals in a single data channel are considered. The effect of introducing synchronized signals into the system is examined, and a qualitative analysis of interference rejection when using the signals is presented. Sequential synchronization involves interrupting uniform convoluted code signals at intervals and inserting the synchronized signal in the resulting burst. Parallel synchronization is accomplished by substituting specific convoluted code test characters with synchronized signals characters. Transl. by E.C.

N70-39961# Academy of Sciences (USSR), Moscow.
CHARACTERISTICS OF DATA DETECTION IN ALTERNATING FREQUENCY COMMUNICATION CHANNELS
N. I. Dushchenko and L. A. Voloshin *In its* Data Transmission Systems, Sect. 4 1969 p 69–74 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Reconstruction of the operating frequency in a broad range to compensate for noise and fading is considered. Methods are analyzed for constructing a channel with a reconstructed carrier frequency in which receipt and transmission of separate characters or groups of characters is realized with frequency changes by a given frequency-time matrix. A comparative analysis is given of the effectiveness of three fundamental principles of information detection in such systems. Signal reception and transmission occurs under complete synchronization of the receiving and transmitting cycles. Transl. by E.C.

N70-39962# Academy of Sciences (USSR), Moscow.
PROCEDURES FOR TECHNICAL FEASIBILITY OF CODING AND DECODING DEVICES
V. A. Emelyanovich and Yu. A. Dodonov *In its* Data Transmission Systems, Sect. 4 1969 p 75–80 In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A procedure is discussed for improving the reliability of digital data transmission in communication channels using Hamming correction code. Coding is carried out simultaneously with data input; separation of data characters from control characters is done independently at the end of the code group. Principles of coding and decoding equipment are examined on the basis of a 20-character code group. Circuit diagrams for the coder and decoder are given. Transl. by E.C.

N70-39963# Academy of Sciences (USSR), Moscow.
TRANSMITTING COMMANDS AND SIGNAL DATA VIA REMOTE CONTROL RELAY DEVICES USING CONSTANT WEIGHT CODES
B. M. Zlotnik *In its* Data Transmission Systems, Sect. 4 1969 p 81–87 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

An algorithm is discussed for transforming several constant weight codes into a single code. The constant weight codes are used in remote control relay and signal branching circuits containing output, communication, and control terminals for frequency multiplexing systems. Transl. by E.C.

N70-39964# Academy of Sciences (USSR), Moscow.
DETERMINING THE ACCESS FREQUENCY FOR CONTINUOUS COMMUNICATION OF DIGITAL DATA
Z. S. Kramov *In its* Data Transmission Systems, Sect. 4 1969 p 88–93 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The dependence was investigated between root-mean-square errors when reestablishing communication from discrete frequencies and quantization error during interpolation of trigonometric polynomials. Formulas and graphs are given for defining a digital communication frequency with limited spectrum by interpolation using a trigonometric polynomial of the second order. Transl. by E.C.

N70-39965# Academy of Sciences (USSR), Moscow.
RELIABILITY PARAMETERS OF DATA TRANSMISSION CYCLES IN REAL TIME SYSTEM
V. I. Karpov and V. M. Shlyaposhnikov *In its* Data Transmission Systems, Sect. 4 1969 p 94–96 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The probability of loss of communication in a cyclic data transmission system is considered. The probability controls the cycle reliability, as well as its design structure, particularly the number of parallel channels and auxiliary data transmitters. Transl. by E.C.

N70-39966# Academy of Sciences (USSR), Moscow.
PROBLEMS OF CONSTRUCTING DIGITAL DATA RELAY SYSTEMS
V. I. Korzhik and L. M. Fink *In its* Data Transmission Systems, Sect. 4 1969 p 97–100 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A sequential channel is examined, containing M links, which connects a digital terminal with users. Each i link is a continuous channel. Linear amplitude and character regeneration methods for signal conversion from the output of the i link to the input of the i + 1 link are investigated. Transl. by E.C.

N70-39967# Academy of Sciences (USSR), Moscow.
PROBLEMS OF CONSTRUCTING DIGITAL DATA RELAY SYSTEMS. PART 2: THE PRINCIPLE OF MAXIMUM REGENERATION
V. I. Korzhik *In its* Data Transmission Systems, Sect. 4 1969 p 101–103 In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A 'sequential' channel of M components connecting a digital source with a user is considered. A converter is located between the output of the i-th component and the input of the following component. The problem considered is the type of converter system in the components which can provide the minimum probability of error in reception of characters by the user. Two methods of conversion are possible: linear amplification and retrieval of binary characters using optimum collectors with subsequent optimal modulation. It is shown that, regardless of the interference in the component receiver, the principle of maximum regeneration is the optimum conversion in a sequential channel for a binary source. Transl. by R.B.

N70-39968# Academy of Sciences (USSR), Moscow.
DIGITAL MODELING AS A METHOD OF INVESTIGATING CONVERTER AND DATA TRANSMISSION SYSTEMS
R. D. Leytes *In its* Data Transmission Systems, Sect. 4 1969 p 104–109 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The digital model is defined as representative of a class of physical models of the functional type. The main steps in the process of constructing the digital model are considered. As an example, the use of the model in investigating the speech conversion mechanism of the speech tract is discussed. The methods of exchanging human speech information with a machine, as in automatic recognition of acoustic patterns and speech synthesis, are indicated. Transl. by R.B.

N70-39969# Academy of Sciences (USSR), Moscow.
THE POSSIBILITY OF INCREASING THE NOISE SUPPRESSION FEATURES OF PULSE COMMUNICATION SYSTEMS
A. G. Leontyev and Yu. N. Kalashnikov *In its* Data Transmission Systems, Sect. 4 1969 p 110–113 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The possibility of using the data on noise superimposed on the signal during reception is considered as a means of improving the signal-to-noise ratio of the system. Expressions are derived for different types of signal modulation for dual channels, one of which is the data channel and the other the compensating channel. The results show that the use of compensation is most effective in pulse-phase and impulse duration modulated channels, which are themselves more noise-stabilized. Transl. by R.B.

N70-39970# Academy of Sciences (USSR), Moscow.
SOME PROBLEMS OF OPTIMAL COMBINATION OF MODULATION AND CODING PROCEDURES IN DATA TRANSMISSION ALONG TELEPHONE CHANNELS
I. A. Mizin, L. S. Urinson, and G. K. Khrameshin *In its* Data Transmission Systems, Sect. 4 1969 p 114–118 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The possibility of increasing the speed and reliability of data transmission along telephone channels by using modem circuits with correlation coupling between signals is considered. Preselected input redundancy is used in modem circuits with correlation coupling between signals to compress the spectrum of the transmitted signal, which in itself permits an increase in the speed of data transmission, and to detect and partially correct errors. The most practical modem circuits are shown to be those using a modified bipolar method of transmission in combination with single sideband phase-amplitude modulation. Transl. by R.B.

N70-39971# Academy of Sciences (USSR), Moscow.
ESTIMATING THE ACCURACY OF DIGITAL TELEMETRIC DATA TRANSMISSION ALONG NOISY COMMUNICATION CHANNELS
M. L. Minevich and B. L. Ryvkin *In its* Data Transmission Systems, Sect. 4 1969 p 119–124 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Expressions are derived for boundary, and in a number of cases, for exact values of average and root-mean-square errors during data transmission by nonredundant binary codes along symmetrical and asymmetrical channels, and also along channels subjected to error bursts. The dependence or lack of dependence of the various types of errors on the code word length is shown. Transl. by R.B.

N70-39972# Academy of Sciences (USSR), Moscow.
SYNCHRONIZING MESSAGES IN TRANSMISSION OF DATA AND SYNCHRONOUS SIGNALS ALONG A SINGLE CHANNEL
I. N. Mishchenko and I. A. Noyikov *In its* Data Transmission Systems, Sec. 4 1969 p 125–129 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Two methods of transmitting data characters and synchronous signals through the same channel are considered. In the first case, the message characters are transmitted by two opposite digital codes, and are periodically interrupted for transmission of the synchronous signals. In the second case, a periodically repeating pseudo-noisy signal is used as the synchronous signal and the message characters are transmitted by inverse modulation of this signal. The noise suppression features in reception of the synchronous signals and data characters are estimated. Transl. by R.B.

N70-39973# Academy of Sciences (USSR), Moscow.
THE EFFICIENCY OF A COMBINED ANALOG-CODE METHOD FOR ERROR DETECTION IN TRANSMISSION OF DIGITAL DATA ALONG COMMUNICATION CHANNELS
V. L. Morev, P. A. Yunakov, and I. I. Chernaya *In its* Data Transmission Systems, Sect. 4 1969 p 131–134 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The probability of error in transmission of data along real-time communication channels is considered. One method of increasing the realiability in such channels is detection of errors in combination with automatic interrogation of blocks or code groups in which the errors are detected. The use of combined analog-code method of protection against error is shown to provide the required reliability with low code redundancy when the channel is in a disturbed state. At the same time the channel capacity is increased significantly, because the signal during the undistributed state is transmitted with much less redundancy than it is when using only code method of protection. Transl. by R.B.

N70-39974# Academy of Sciences (USSR), Moscow.
USING THE REDUNDANCY OF THE SINGLE SIDEBAND SIGNAL OF RELATIVE PHASE TELEGRAPHY
V. V. Pavlyuk *In its* Data Transmission Systems, Sect. 4 1969 p 135–139 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The ratio of transmission speed to the occupied band is investigated with respect to single sideband transmission in relative phase telegraphy. Transmission efficiency is significantly increased and the occupied band can be reduced by a factor of two by using single sideband transmission. By comparing the signals at the output of the cophasal and square law channels and using the difference in the errors of both channels, the noise suppression features of the system are enhanced. Transl. by R.B.

N70-39975# Academy of Sciences (USSR), Moscow.
CALCULATING THE OPTIMUM LENGTH OF THE CODE WORD AND MESSAGE IN A DATA STORAGE SYSTEM
O. G. Protopopov, Yu. P. Pekin, and V. A. Shcherbanov *In its* Data Transmission Systems, Sect. 4 1969 p 140–144 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Mathematical expressions are derived for finding the message and code word lengths such that data transmission efficiency is maximum. A semi-duplex data storage system is considered in which the message consists of several code words. Correction codes are used in the system for detecting errors, which is accomplished by repeated transmission of the message. The optimum length of the message, the optimum length of the cyclic code combination for error detection, and the required number of repeats of the code word in the message are calculated as a function of the state of the channel. Transl. by R.B.

N70-39976# Academy of Sciences (USSR), Moscow.
THE EFFICIENCY OF FREQUENCY CONTROL IN CHANNEL MONITORING SYSTEMS
L. Ye. Radyuk and A. F. Terpugov *In its* Data Transmission Systems, Sect. 4 1969 p 145–149 ref In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The efficiency of monitoring systems for radar stations is investigated with respect to controlling the frequency of the search

pulse as a function of observation results. The quality of the system operation is characterized by the probability of false alarm error and the average time between conversion of the channel to a given state when the target first appears and the moment a decision is made that the channel is in a state to detect the target.
Transl. by R.B.

N70-39977# Academy of Sciences (USSR), Moscow.
ESTIMATING THE EFFICIENCY OF CERTAIN ADAPTIVE METHODS FOR INCREASING THE RELIABILITY OF DIGITAL DATA RECEPTION
N. B. Rezvetsov *In its* Data Transmission Systems, Sect. 4 1969 p 150–155 In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

The maximum power efficiency of certain adaptive methods for reducing concentrated interference signals is considered for the case of using linear devices with variable parameters for digital data reception. The estimation is made for an idealized case on the assumption that no errors exist during analysis of the interference state, and that no dynamic errors exist in controlling the parameters of the receiver and the signal. The digital transmission system is investigated by using characters in the form of a finite sum of orthogonal functions processed by a linear receiver with variable parameters.
Transl. by R.B.

N70-39978# Academy of Sciences (USSR), Moscow.
THE POSSIBILITY OF REPLACING ALPHABETS OF SIGNALS WITH ANALOG ANGLE MODULATION BY SIGNALS WITH DIGITAL PHASE SHIFTS
N. B. Rezvetsov, Ye. S. Chernolutskaya, and V. A. Vasilyev *In its* Data Transmission Systems, Sect. 4 1969 p 156–161 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

An estimate is made of the proximity between signals with digital phase shift and arbitrary signals with a given law of phase shift, such as those with angle modulation, having a constant amplitude. Approximation of an alphabet of biorthogonal frequency-modulated signals for use in digital data transmission systems is given as an example. The use of signals with digital phase shift permits control of the shift in frequency interval and utilization of simple flip-flop and trigger devices in formation of signals and control of their shape.
Transl. by R.B.

N70-39979# Academy of Sciences (USSR), Moscow.
METHODICAL ERRORS IN RETRIEVAL OF INFORMATION COMPRESSED ACCORDING TO A CERTAIN ALGORITHM FOR REDUCING REDUNDANCY
O. B. Rosenbauli, R. N. Rodin, A. P. Davydov, and A. P. Zharkov *In its* Data Transmission Systems, Sect. 4 1969 p 162–167 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A method is outlined for estimating the upper bound of the maximum error in retrieving telemetric data processed according to an algorithm for reducing redundancy, the main element in which is assignment of the transmission band for input signal increments. The upper bound of maximum error, based on the allocated difference in increments, is the determining function of the compression factor. Experiments show that the maximum errors do not exceed a given level when using the derived algorithm.
Transl. by R.B.

N70-39980# Academy of Sciences (USSR), Moscow.
SINGLE-TEST DATA EXPONENTS FOR REDUCING REDUNDANCY
O. B. Rosenbauli, R. N. Rodin, and V. S. Shatkhin *In its* Data Transmission Systems, Sect. 4 1969 p 168–173 In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

When using known methods of reducing redundancy and when developing new ones, the determining factor is the efficiency of the methods, which is controlled by the compression factor of the method and the complexity of the resulting structure. One method of reducing redundancy is considered and the maximum number of selections per given interval, which determines monotonally the variable portion of the process being measured, is estimated. Expressions are derived for the maximum number of selections in processing certain analytical functions.
Transl. by R.B.

N70-39981# Academy of Sciences (USSR), Moscow.
CONSTRUCTING AN ADAPTIVE CONTROL SYSTEM AS A QUEUEING SYSTEM
O. B. Rosenbauli, R. N. Rodin, P. N. Shkatov, and Yu. A. Shumov *In its* Data Transmission Systems, Sect. 4 1969 p 174–179 In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Agreement between data input rate and the channel capacity of data transmission in adaptive control systems is accomplished by data reduction, as a result of which the measurements from random access flow calculated according to queueing theory. A mathematical model of operation and the results of digital modeling of a buffer memory as an element which coordinates the source of random accesses with a data transmission channel having constant and limited capacity are derived.
Transl. by R.B.

N70-39982# Academy of Sciences (USSR), Moscow.
CALCULATING THE MINIMUM REDUNDANCY OF SYNCHRONOUS DATA FOR A COMMUNICATION NETWORK
G. I. Ruzaykin *In its* Data Transmission Systems, Sect. 4 1969 p 180–183 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

In certain communication networks special attention must be given to the problem of the beginning of operation by subscribers, it being assumed that the beginning of operation is determined by the receipt of a certain amount of synchronous data by all subscribers. A computational scheme is given for calculating the minimum redundancy of synchronous data being transmitted at a given probability of correct reception.
Transl. by R.B.

N70-39983+ Academy of Sciences (USSR), Moscow.
ON ONE PROBLEM OF STATISTICAL SYNTHESIS
D. I. Shapiro *In its* Data Transmission Systems, Sect. 4 1969 p 185–190 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

A hierarchical control system is considered in which a specific decision made by the controlled object corresponds to specific input data at each step. The problem consists of deriving the characteristics of the input flow from data at the output of the object, it being assumed that sources of noise with known statistical properties are present in the system.
Transl. by R.B.

N70-39984# Academy of Sciences (USSR), Moscow.
PREDISTORTION OF SPEECH SIGNALS IN QUANTUM TRANSMISSION
V. M. Shteyn *In its* Data Transmission Systems, Sect. 4 1969 p 191–196 refs In RUSSIAN (See N70-39951 22-07)
Avail: NTIS

Results of numerical calculations which take into account the speech spectrum and characteristics of typical telephone apparatus are presented. When pulse code or delta modulation is used for quantum speech transmission, compounding is employed

and quantization noise appears together with the speech signal and disappears during pauses. At optimum predistortion, signal power may be equal to that of noise quantization, and quantization may be regarded as signal distortion rather than as noise.
Transl. by R.B.

N70-40058# Naval Civil Engineering Lab., Port Hueneme, Calif.
NUCLEAR ELECTROMAGNETIC PULSE PROTECTIVE MEASURES APPLIED TO A TYPICAL COMMUNICATIONS SHELTER
H. A. Lasitter and D. B. Clark Apr. 1970 157 p refs
(AD-707696; NCEL-TN-1091) Avail: NTIS CSCL 17/2

A detailed study of a typical communication facility has been made to determine the requirements for the installation of nuclear electromagnetic pulse (NEMP) protection measures. Necessary hardening measures have been determined on the basis of a single point failure analysis and the assignment of priorities to the various systems and components encountered. Protective devices have been applied to power control and signal lines entering and within the complex as well as to electrically powered life support systems. NEMP hardening techniques and methods have been applied to non-electrical shelter penetrations as necessary and other applicable areas within the facility such as non-strategic lines, grounding systems, and cable routing.
Author (TAB)

N70-40063* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
INFLATABLE RADAR REFLECTOR UNIT Patent
Matthew I. Radnofsky and Glenn A. Shewmake, inventors (to NASA) Issued 14 Dec. 1965 (Filed 14 Jan. 1963) 6 p Cl. 343-18
(NASA-Case-XMS-00893; US-Patent-3,224,001; US-Patent-Appl-SN-251449) Avail: US Patent Office CSCL 09E

A buoyant reflector unit which by its reflectivity is adapted to permit radar indication of its location on the surface of the sea from great distances is described. This device is highly reflective to electromagnetic radiation of the radio microwave frequencies and is adaptable for erection and deployment at the side of the downed aircraft or other object to be located. It further fulfills the requirements for spaceborne/airborne equipment by being of very lightweight and reducible to a very small size for compact packaging and minimum storage space. This unit possesses the rigidity that renders it the structural integrity to resist wind and maintain its functional configuration and orientation. In addition, it requires only a minimum expense of time and effort to erect and deploy the reflector, it is also self-buoyant and seaworthy thus obviating the need of any complementary supporting structures.
E.M.C.

N70-40072# Naval Postgraduate School, Monterey, Calif.
A STUDY IN THE CONCEPT OF PROBABILITY FILTERING
Lawrence Ira Astor (M.S. Thesis) Apr. 1970 34 p refs
(AD-707735) Avail: NTIS CSCL 9/4

The mathematical expectation formed from the first probability distribution lends itself well to implementation of a filtering device. This device, or probability filter, is discussed here conceptually and is computer simulated to obtain characteristics and performance of information in jamming and non-jamming environments.
Author (TAB)

N70-40097# Illinois Univ., Urbana. Antenna Lab.
INVESTIGATION OF A CLASS OF ELECTROMAGNETIC BOUNDARY VALUE PROBLEMS Final Report, 1 Feb. 1969—31 Jan. 1970
Raj Mittra Feb. 1970 18 p refs *Its* Antenna Lab. No. 70-4
(Contract F19628-69-C-0015)
(AD-707845; UILU-eng-70-304; AFCRL-70-0266) Avail: NTIS CSCL 20/14

The purpose of this project was to apply a class of newly developed techniques to the solution of problems involving waveguide discontinuities, scattering, and diffraction as well as inverse scattering problems. Another objective of the project was to study image processing and inverse scattering techniques involving coherent fields. A rather large number of waveguide as well as open-region boundary value problems has been investigated using the modified residue calculus technique and extended versions of the same. The relative advantages of these methods over conventional numerical methods have been demonstrated. Investigation of the inverse scattering problem between parallel planes has been completed. The inverse scattering approach has been extended to solve the problem of scattering from cylinders of arbitrary cross section.
Author (TAB)

N70-40128# Harvard Univ., Cambridge, Mass. Acoustics Research Lab.
SIGNAL-RATE PROCESSING FOR TRANSIT DETECTION. 1: EXPERIMENTAL TEST EQUIPMENT FOR A TIME SCALED MODEL
Frederick V. Hunt May 1970 91 p refs
(Contract N00014-67-A-0298-0007)
(AD-707770; TM-64) Avail: NTIS CSCL 20/3

Equipment for conducting a comprehensive experimental investigation of a novel method of signal-rate processing for transit detection was designed, constructed, and assembled. The present second-generation test equipment consists of three major segments: a time-scaled model of the signal processor, a broadband (400 MHz) noise generator whose amplitude can be modulated by a control voltage, and a transit simulator that generates a control voltage suitably tailored to make the time variation of the noise envelope simulate the variation of total signal power that would be received by a sensor during an actual source transit. The apparatus is elaborated to permit the controlling parameters to be varied over wide ranges, and the non-dimensional experimental variables are made available as direct-reading front-panel controls. Getting valid measures of detection and false-alarm probabilities within a reasonable time is facilitated by choosing a time-scaling factor (about 100,000) that allows a run of 10,000 transits to be completed within 30 seconds. The design rationale and alignment instructions are supplied in sufficient detail to qualify this document as an instruction manual for the use, repair, or duplication of the equipment.
Author (TAB)

N70-40159# Naval Research Lab., Washington, D.C.
SIMULATED OCEAN RADAR IMPULSE RESPONSES FROM LUNAR RADAR MEASUREMENTS
A. Shapiro, B. S. Yaplee, and E. A. Uliana 7 May 1970 22 p
(AD-707072; NRL-7050) Avail: NTIS CSCL 17/9

Measurements of the radar impulse response from rough surfaces should provide criteria for relating the radar return with the vertical structure of these surfaces. Such information is needed to use more efficiently ocean satellite radar observations for describing sea surface structure. While no direct measurements of the radar impulse response are available from a fluid surface, the NRL lunar high-range-resolution radar observations can provide equivalent radar impulse response measurements from a solid rough surface. The lunar radar measurements were used to simulate the ocean impulse response, and thus provide some insight into the effect of different surface roughnesses on the radar return. The radar returns from five lunar areas of different surface roughness were analyzed and the impulse response derived. The results indicate that the size of the vertical structure correlates with the width of the impulse response, and that quantitative information concerning the parameters of mean height and surface roughness can be obtained by computing the power centroid and standard deviation of the impulse response. However, due to the nonuniform distribution of the lunar surface features, the two parameters will depend on the particular location of the surface features and the scanning speed of the radar observations.
Author (TAB)

N70-40178# Naval Postgraduate School, Monterey, Calif.
LINEAR INTEGRATED CIRCUITS IN A CHANNELIZED HIGH-FREQUENCY RECEIVER
Russell Kingman Shields (M.S. Thesis) Dec. 1969 49 p refs
(AD-708045) Avail: NTIS CSCL 17/2

An application of modern linear integrated circuits to the design of a channelized high-frequency radio receiver is presented. The results of testing a prototype, crystal-controlled, fixed-tuned integrated-circuit receiver front end and wideband frequency-conversion stage are shown. Probelms of image rejection with single frequency conversion are discussed. The design of a channelized receiver section using modern special-purpose linear integrated circuits is shown. Author (TAB)

N70-40187# Human Factors Research, Inc., Santa Barbara, Calif.
A METHOD FOR THE SYSTEMATIC DESIGN OF A SUBMARINE SONAR DISPLAY/CONTROL SUBSYSTEM
William Doobenen Oct. 1969 36 p refs
(Contract N00024-64-C-1369)
(AD-708746; TR-796-3) Avail: NTIS CSCL 17/1

A method is outlined for the systematic design of a submarine sonar display/control subsystem. The unique nature of the submarine sonar operators functions is the primary determinant of the design procedure. The results are presented as a 67-step procedure within the context of the overall system design process. Author (TAB)

N70-40202* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COLLAPSIBLE LOOP ANTENNA FOR SPACE VEHICLE
Patent
Leonard L. Mitchum, Jr. and Hermann R. Wagner, inventors (to NASA) Issued 12 Feb. 1963 (Filed 29 Jun. 1961) 10 p Cl. 343-705
(NASA-Case-XMF-00437; US-Patent-3,077,599; US-Patent-Appl-SN-120795) Avail: US Patent Office CSCL 09E

A loop antenna system mounted on a space vehicle is described which is designed to use the rotation of the vehicle about its spin axis to provide the operating force to erect the antennas from a folded position. The system comprises a loop antenna collapsibly supported about and encircling the circumference of the vehicle housing shell, a central control mechanism mounted within the housing shell, and a plurality of control cords suitably attached to the central control mechanism and extending on through the housing shell to select points of the antenna where they are also attached. A plurality of support arms are used to collapsibly support the loop antenna from the housing shell. The control cords are guided through the housing shell by pully means and led from the central control mechanism by guide means. The antenna system is erected from its folded position by the centrifugal forces created within the support arms when the vehicle is rotating, these forces causing the support arms to swing outward from the spin axis and drag the antenna from its folded position to its extended position. P.A.B.

N70-40227# Signals Research and Development Establishment, Christchurch (England).
A 1 km RANGE OPTICAL LINK FOR VIDEO SIGNALS INCORPORATING A SIMPLE AGC AND TEMPERATURE COMPENSATION CIRCUIT FOR AVALANCHE PHOTODIODES
M. J. Dore Apr. 1970 10 p refs
(AD-708677; SRDE-70018) Avail: NTIS CSCL 17/2

Gallium arsenide lamps and silicon avalanche detectors are reliable components for optical communication. It has been shown that direct analogue modulation is probably the best approach to a 1Km range optical communication link for video bandwiths. This memorandum describes briefly experimental terminals for such a link. Laboratory measurement indicated that a clear weather in hand factor of 13dB or more above the 30dB S/N ratio needed should be achieved resulting in an expected outage time of less than 10 days per year. A simple AGC and temperature stabilization circuit for avalanche diodes is described. Author (TAB)

N70-40259# General Instrument Corp., Hicksville, N.Y. Electronic Systems Div.
RADAR SET AN/PPS-( ) (FAILURE FREE DEVELOPMENT PROGRAM) Interim Development Report, 28 Mar.–30 Apr. 1970
Apr. 1970 54 p
(Contract N00039-70-C-3501)
(AD-707781; ESD-1158-IR-3) Avail: NTIS CSCL 17/9

The report covers the Phase 2 portion of the program to design, manufacture and test 20 high reliability versions of the AN/PPS-6 battlefield surveillance radar. Author (TAB)

N70-40301# Syracuse Univ. Research Corp., N.Y. Defense Systems Div.
HARDENING OF THE MODIFIED AN/TPS-25 RADAR FOR FIELD TESTING Final Report, 24 Jun. 1968–8 Jul. 1969
Ronald Doan Feb. 1970 73 p refs
(Contract DAAB07-68-C-0406)
(AD-708111; DSD-R-273) Avail: NTIS CSCL 17/9

An in-house-built model of a non-coherent doppler, monopulse tracking radar, (modified AN/TPS-25) was refined, tested and hardened to a point suitable for tracking tests. Tracking tests were run on a jeep vehicle using a movie camera to record tracking data. Author (TAB)

N70-40366# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF AMPLITUDE PULSATIONS OF A RECEIVED SIGNAL ON THE OPERATION OF A TRACKING DIRECTION FINDER WITH CONICAL SCANNING
A. M. Taraskin et al 17 Apr. 1970 15 p refs Transl. into ENGLISH from Tr. Uralsk. Politekhn. Inst. (Sverdlovsk), no. 168, 1968 p 59–67
(AD-708444; FTD-HT-23-179-70) Avail: NTIS CSCL 17/3

Because in a tracking direction finder with conical scanning tracking breakdown can result from signal amplitude pulsations, the parameters of the noise in the form of harmonic oscillations are evaluated by using simulation techniques. The analysis involves a Taylor series expansion of the output voltage. Expressions are developed for the antenna directivity and for tracking characteristics. The analysis confirms the high chance of tracking breakdown from multiplicative noise at frequencies close to the scanning frequency. The target tracking error is determined by noise levels, their frequency, and the target speed. The error is larger than the dynamic error without noise, even if the frequency lies outside the effective noise band. The region of the noise parameters in which the breakdown occurs depends to a small degree on the direction finder quality, and to a larger degree on the ratio of the target speed to the limitation level of the antenna rotation speed. The degree of effectiveness of the pulsating noise is directly related to the degree of concentration of its spectrum at the scanning frequency. Any theoretical analysis used must take into consideration the antenna rotation speed as the main factor controlling the onset of breakdown. Author (TAB)

N70-40368# Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
AN/PPS-( ) ULTRA RELIABLE RADAR Interim Development Report, 1–31 May 1970
J. D. Frattura 8 Jun. 1970 39 p
(Contract N00039-70-C-3502)
(AD-707807) Avail: NTIS CSCL 17/9

The program covers the study, design, construction, test, analysis and inspection of a complete and operative, highly reliable, relatively failure-free version of the pulsed doppler surveillance AN/PPS-6 radar set. The radar set is intended to be a lightweight, miniaturized, X-Band, pulsed doppler combat surveillance radar. The basic purpose of this program is to develop a highly reliable radar set considering the overall cost of ownership when development, production and maintenance costs are taken into account while keeping the same general performance, form-factor and weight as the AN/PPS-6 radar. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N70-39028# New York Univ., N.Y. AEC Computing and Applied Mathematics Center.
A REMOTE ENTRY SYSTEM FOR THE CDC 6600
E. Franceschini, Y. Feinroth, and M. Goldstein Apr. 1970 53 p refs
(Contract AT(30-1)-1480)
(NYO-1480-148) Avail: NTIS

The remote entry system services both interactive time-sharing (CDC INTERCOM) and batch job processing (NYU XREMOTE). Central to the system is a 16 bit Honeywell DDP minicomputer which is interfaced to the CDC 6600. The DDP can be conceived as the front end of the larger computer serving the dual functions of I/O controller and temporary storage. The I/O in this sense includes both physical input/output and such pre-processing as error checking, control character processing, code translations, character blocking, etc. By moving these functions out of the central computer, considerable flexibility has been gained. Author

N70-39088# Sandia Corp., Albuquerque, N.Mex.
FERROELECTRIC MEMORY DEVICE PARAMETER STUDY
H. C. Shefelbine May 1970 81 p refs
(SC-RR-69-384) Avail: NTIS

The results of a two-year study into the electrical and environmental characteristics of ferroelectric ceramic memory discs is summarized. The investigation was undertaken to determine the applicability of such devices to a memory where fast writing speed is not needed but where retention of information for long storage times is. NSA

N70-39178# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology.
INFORMATION STORAGE AND DATA MANIPULATION IN SCINTISCANNING
H. L. Friedell, A. Rejali, and E. C. Gregg [1969] 6 p refs Presented at the Intern. Meeting on the Use of Computers in Radiol., Brussels
(Contract W-31-109-eng-78; Grant PHS-AM-06760)
(COO-78-218; CONF-690953-1) Avail: NTIS

An analog-digital computer system for the storage and manipulation of radioisotope scan data is described. The system can be used with either a scintillation camera or mechanical scanner. The final record is digital and independent of the characteristics of the recording device. Permanent time records of the sequence of uptake, dilution, and clearance of radioisotopes or labeled compounds are available for viewing with only about five minutes time required between the finished scan and final record. NSA

N70-39181# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology.
ANALOG TECHNIQUES FOR PROCESSING IMAGE DATA
E. C. Gregg [1969] 17 p refs Presented at the 1st Bien. Conf. on Quant. Organ Visualization in Nucl. Med., Miami, Fla.
(Contract W-31-109-eng-78; Grants PHS-AM-06760; PHS CA-08034)
(COO-78-215; CONF-700516-1) Avail: NTIS

Analog computer techniques for processing radioisotope scan data are discussed. It is pointed out that, while an analog computer is inherently a one dimensional system, it is possible to perform two dimensional isotropic operations such as filtering; aperture correction; profiling; and contour enhancement. An overall accuracy of 0.01% is attainable in most of the analog mathematical manipulations and computing times on the order of nanoseconds may be achieved. NSA

N70-39472# Addis Translations International, Woodside, Calif.
DISPLAY SYSTEM FOR THE PERIODICALS FILE. OPERATION MANUAL [SYSTEME D'AFFICHAGE DU FICHIER DES PERIODIQUES, MANUEL D'OPERATION]
Jun. 1969 58 p Transl. into ENGLISH of BIRO, Quebec, publ. 81 In ENGLISH and FRENCH Prepared for Calif. Univ., Livermore. Lawrence Radiation Lab.
(UCRL-Trans-10356; B-1) Avail: NTIS

The records, a set of data pertaining to the periodicals now at Laval University, are stored permanently on disk storage units connected directly to the computer at the University's Data-Processing Center. The aim of the display and updating system is: to make it easy to consult records by means of a visual-display unit to make it possible, with certain restrictions, to modify an existing record, and to produce a new record or delete it. This manual was designed as a guide for users of that system. It contains all the information required for operation of the IBM 2260 visual-display units, which are connected directly to the IBM 360 computer. Author

N70-39473*# Bellcomm, Inc., Washington, D.C.
BCMIO: THE BELLCOMM EXEC 8 FORTRAN I/O LIBRARY
W. M. Keese 15 Sep. 1970 18 p refs
(Contract NASw-417)
(NASA-CR-113600; TM-70-1031-2) Avail: NTIS CSCL 09B

Efficiency of the UNIVAC 1108 computer is frequently controlled more by the programming of input/output than it is by the programming of the computations. Programs written in the FORTRAN language effect their input/output through implicit use of a set of subroutines called the FORTRAN I/O library. A new Exec 8 library, BCMIO, was programmed at Bellcomm to conform to the standard format established by the UNIVAC Standard Exchange. In order to use the library, it is necessary to convert data files to the BCMIO format but program alterations are not required. BCMIO reduces program execution times by 20-86%. Taking 50% as the midpoint of this range, and assuming that half of the machine time is devoted to program execution there is a UNIVAC 1108 throughput increase of 33% resulting from use of the new library. Author

N70-39488 Advisory Group for Aerospace Research and Development, Paris (France).
AIR AND SPACEBORNE COMPUTERS
Edward Keonjian, ed. (Grumman Aerospace Corp.) Apr. 1970 191 p refs Lecture Ser. Held at Amsterdam, Farnborough, Engl. and Bologna, Jun. 1968
(AGARDograph-127) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

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N70-39490 Elliott Btos., Ltd., London (England).

THE IMPACT OF COMPUTERS ON THE OVERALL DESIGN OF AEROSPACE SYSTEMS

P. B. Rayner *In* AGARD Air and Spaceborne Computers Apr. 1970 p 15–20 (See N70-39489 22-08)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

Some of the early arguments put forth for digital systems are advanced, and the practical aspects of producing and operating a digital aerospace system are considered. The merits of digital systems are described, including computing power, flexibility in development, commonality, reliability, digital communication, and cost factors. Incremental and whole number computers are discussed, along with real time and on-line systems. Digital technique potentials are examined with respect to control theory, system integrity, aircraft electrical systems, and the physical environment. The development of digital applications is considered concerning navigation and control systems, along with central and distributed computer concepts. Future developments in digital technology are predicted as they relate to aircraft or space vehicle usages. P.A.B.

N70-39491 Ecole Nationale Superieure de l'Aeronautique, Paris (France).

SPECIAL COMPROMISES AND CONSIDERATIONS [COMPROMIS ET CONSIDERATIONS SPECIALES]

Jean-Jacques Mayer and Jean Chinal *In* AGARD Air and Spaceborne computors Apr. 1970 p 21–37 In FRENCH (See N70-39489 22-08)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

The different parameters influencing the design of aerospace computers are examined with relation to the interactions between them and the necessary compromises which result from these interactions. The electrical configuration and technology and the complexity of the logic circuits, memory, and programming are first treated. Computer performance criteria, probability of accomplishing given tasks in given times, and maintainability are then considered. The environments in which the computer will function and operational specifications are also necessary considerations. Transl. by P.A.B.

N70-39492 International Business Machines Corp., Oswego, N.Y.

STRUCTURE OF AN AEROSPACE COMPUTER FAMILY

W. J. Patzer *In* AGARD Air and Spaceborne Computers Apr. 1970 p 39–56 refs (See N70-39489 22-08)

Copyright. Avail: Technivision, Braywick, House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

The underlying commonality of structure possible in a family of ruggedized aerospace digital computers is described. The major facets considered are architecture, hardware, and support software. Advantages to both the supplier and user are identified. To achieve acceptable cost performance for a broad range of aerospace applications, creation of specialized computer system architectures for various segments of the market is often required. Characteristics of the problem to be solved as well as the economics of sound system design are major contributors in shaping the digital computer parameters. Nevertheless, significant areas of commonality between equipments destined for diverse applications can be retained to provide advantages in initial cost, early availability, maintenance and logistics, training, program generation, and system upgrading to manufacturer and customer alike. The tradeoffs considered in the IBM aerospace computer product line are described. Author

N70-39495 International Business Machines Corp., Oswega, N.Y.

AEROSPACE SYSTEMS IMPLICATIONS OF MICROPROGRAMMING

W. J. Patzer and G. C. Vandling *In* AGARD Air and Spaceborne Computers Apr. 1970 p 87–97 refs (See N70-39489 22-08)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

The characteristics of microprogrammed and conventional general purpose computers are compared. The microprogrammed computer is first characterized as a system component. Secondly, the system design flexibility provided by microprogram control is qualitatively illustrated. Attention is focused upon three systems engineering considerations: (1) Specialized operations: A microprogrammed computer organization is shown to be well suited to applications where very specialized tasks require a significant percentage of total execution time. (2) Restructurable architecture: The ease with which the computer instruction set, data representation, interrupt system, and input/output system can be restructured via microprogramming is shown to be a significant consideration. (3) Efficient simulation: The unique capability for efficient simulation (emulation) inherent in microprogrammed computers is shown to permit a significant reduction in development time and overall cost when a previous system is upgraded or an experimental system is used. Author

N70-39496 North American Rockwell Corp., Anaheim, Calif.

MODULAR COMPUTER SYSTEM ARCHITECTURE

J. Weissman *In* AGARD Air and Spaceborne Computers Apr. 1970 p 99–112 (See N70-39489 22-08)

Copyright. Avail: Technivision, Braywick House, Maidenhead,

Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

The modular computer system presented consists of a set of off-the-shelf, widely applicable modules and design practices that enable quick realization of avionic computing systems. Off-the-shelf items are defined. Each consists of basic computer elements such as memories, registers, arithmetic units, and control units. The basic ingredients of a modular computer system and the practices and techniques of configuring a system for a given application are discussed. It is shown that such a system, even when utilizing a maximum of off-the-shelf components, enjoys computational abilities equal to specially designed computing systems. The multi-processing capabilities of the modular computer system, which are the reasons for its computing advantages, are stressed. Author

N70-39497 Sperry Rand Corp., Philadelphia, Pa. UNIVAC Div.

LARGE SCALE INTEGRATION

L. M. Spandorfer *In* AGARD Air and Spaceborne Computers Apr. 1970 p 113 - 126 refs (See N70-39489 22-08)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

The concept of large scale integration of semiconductor circuits is reviewed. A discussion of LSI rationale, long range technological forecasts, economic prospects, and problems is followed by a review of fabrication processes for bipolar and MOS devices, along with a description of the major characteristics and potential of each. A summary of partitioning studies and a brief review of the status of hardware/software tradeoffs are provided. Author

N70-39498 Sperry Rand Corp., Philadelphia, Pa. UNIVAC Div.

NEW MEMORY AND STORAGE TECHNIQUES

L. M. Spandorfer *In* AGARD Air and Spaceborne Computers Apr. 1970 p 127 - 140 refs (See N70-39489 22-08)

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Recent advances in memory technology are described. Initial emphasis is placed on various types of magnetic film structures and semiconductor cells which are currently in or are likely soon to be in production. The status of content-addressable and read-only memories is discussed. A brief description of new experimental media which show promise in future mass memory applications is given, including propagating domain walls, sonic films, and optic beam addressable approaches. Author

N70-39499 Teledyne Systems Corp., Hawthorne, Calif.

OPTIMAL PACKAGING APPROACHES

R. F. Redemske *In* AGARD Air and Spaceborne Computers Apr. 1970 p 141 - 150 (See N70-39489 22-08)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks., Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, N.Y. 10803 (attn. Mr. A. L. Candido)

The design considerations for optimizing the packaging approach for a microelectronic digital computer for air or space borne application are presented. The packaging approach is dominated by the use of integrated circuits and the problem of how best to utilize them. The alternatives to be considered are two-fold: (1) Use the integrated circuit in the standard package configuratons of TO-5 cans or flat packs as supplied by the semiconductor manufacturer. (2) Use a hybrid packaging approach with multiple integrated circuits per package. Author

N70-39500 Teledyne Systems Corp., Hawthorne, Calif.

SYSTEM AND HARDWARE DESIGN CONCEPTS FOR ULTRA SURVIVABLE AND MAINTAINABLE COMPUTERS

E. Kanter *In* AGARD Air and Spaceborne Computers Apr. 1970 p 151 - 163 (See N70-39489 22-08)

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The following design objectives are set forth: a hardware organization for the positive detection of any critical part failure and for the positive isolation of the malfunction to the easily replaceable assembly or module; a system design that provides for automatic reconfiguration of the still operational elements after detection and isolation; and a hardware and system design that permits on-board repair for the manned space vehicle applications and flight line repair for aeronautical applications. Environmental conditions and specifications are considered, along with technological possibilities to meet these requirements. Packaging and logic design are treated from a conceptual point of view, and the system aspects of microelectronic mechanization are discussed. It is stated that mathematical operators may be organized into groups, each group providing the mechanization of a separable or partitioned function. With the classes of applications restricted to navigation and guidance functions, the concept is developed of a single computer unit which contains its own spares, all modules being identical, is its own tester, and requires no special tools for test or maintenance. P.A.B.

N70-39511# Illinois Univ., Urbana. Coordinated Science Lab.

SOME RELATIONSHIPS BETWEEN REGULAR EXPRESSIONS AND THE STRUCTURE OF SEQUENTIAL MACHINES

Alan Kent Winslow May 1970 52 p refs

(Contract DAAB07-67-C-0199; GRANT NSF GK-15459)

(AD-707685; R-468; UILU-eng-70-213) Avail: NTIS CSCL 09B

It is the purpose of the report to develop techniques by which information concerning the number of states required in a sequential machine corresponding to a given regular expression may be obtained directly from that regular expression without generation of the state table description. Any such procedure, to justify its existence, must be relatively easy to use; otherwise it would be preferable to develop the state table description. Thus the report will attempt to develop tight upper bounds on the number of states in the corresponding sequential machine from an examination of the structure of a regular expression. TAB

N70-39522# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

DESIGN AND BEHAVIOR OF TSS/8: A PDP-8 BASED TIME-SHARING SYSTEM

Ad van de Goor (Ph.D. Thesis) Apr. 1970 214 p refs

(Contract F44620-67-C-0058)

(AD-707867; AFOSR-70-1690TR) Avail: NTIS CSCL 9/2

The thesis is an existence proof of a small scale time-sharing system implemented on a PDP-8 computer. It includes hardware design, system software design, and performance analysis, to which special attention is given. A description of the complete system is given together with the reasoning behind the major decisions. The performance analysis was done in parallel with the design and implementation of the system. Methods were developed to measure the runtime of individual editor and focal commands on a standard PDP-8 computer as well as the response time of the time-sharing system. Several analytical models were used to predict the performance of the system and an accurate simulation model was designed. A comparison of the measured performance results with the predicted results of the simulation and analytical models shows their accuracies. The simulation model was used to study the influence of certain system parameters (e.g., sweeptime and scheduling algorithm) on the system performance; this led to the system configuration of the Carnegie-Mellon University system. Author (TAB)

N70-39544# Washington Univ., Seattle. Dept. of Psychology.
A USER'S GUIDE TO THE OPERATION OF AN INFORMATION STORAGE AND RETRIEVAL SYSTEM ON THE B5500 COMPUTER
Jeanne M. Finke 17 Apr. 1970 116 p refs
(Grant AF-AFOSR-1701-69)
(AD-708190; AFOSR-70-1795TR; Rept-70-1-3) Avail: NTIS CSCL 9/2

The manual describes an information storage and retrieval (IS and R) system implemented on the University of Washingtons Burroughs B5500 computer. This IS and R capability can be applied to a class of file management problems, known as descriptor systems. The implementation of this capability is based on the large capacity storage organization scheme developed by Kidall. The manual is divided into four sections: introduction and terminology, system description, a formal language description of the user command language (including syntax, semantics, and examples), and operational characteristics. The manual is designed to be a reference tool for the user of the IS and R system. TAB

N70-39546# RAND Corp., Santa Monica, Calif.
THE GRAIL LOGICAL INPUT/OUTPUT PROCESSES
T. O. Ellis, J. F. Heafner, and W. L. Sibley May 1970 46 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-708025; RM-6257-ARPA) Avail: NTIS CSCL 9/2

The Memorandum on the operation and organization of the interactive, on-line GRAIL system describes the logical I/O processes that transmit data between primary and secondary storage. Such transfers involve reading from secondary into primary storage and writing from primary into secondary. Four types of data sets are considered: (1) ring structures--list structures linked unidirectionally that represent secondary storage space allocations and the logical descriptions of user-drawn processes; (2) display frames--the internal representation of the displayed information; (3) text planes--the internal representation of user-supplied character strings (text display frames); and (4) read-only process groups--collections of executable programs. Data transmission is synchronized with other system operations to optimize response time and exploit the parallel processing organization of the system software. TAB

N70-39650# State Univ. of New York at Buffalo. Digital Systems Lab.
DESIGN OF MULTIPLE-VALUED LOGIC SYSTEMS Final Report
Donald D. Givone and C. Michael Allen Jun. 1970 56 p refs
(Contract N00014-69-C-0313)
(AD-708053) Avail: NTIS CSCL 9/2

The report presents additional properties of the algebra originally proposed by Allen and Givone. In particular, it is shown how simultaneous equations in the Allen-Givone algebra are solved and how the algebra can be applied to a class of multiple-valued sequential circuits. TAB

N70-39688# Illinois Univ., Urbana. Coordinated Science Lab.
INFINITE STRINGS OVER FINITE MACHINES
Harold Randall Johnson (Ph.D. Thesis) Jun. 1970 94 p refs
(Contract DAAB07-67-C-0199)
(AD-707687; R-471; UILU-eng-70-216) Avail: NTIS CSCL 9/2

Several authors have proposed conditions under which infinite input strings are defined by finite state machines. Corresponding to each definability condition is the class of all sets of infinite strings defined by finite machines with respect to that condition, for a fixed input alphabet. This thesis considers a family of definability conditions. This includes four countably infinite sequences of additional definability conditions. The resulting family of sets of infinite strings defined by a fixed but arbitrary machine M is partially ordered with respect to inclusion. Necessary and sufficient conditions for these inclusions to be strict are developed. Each of these conditions is decidable. Some decidability problems for individual sets are examined, and some boolean identities between such sets are presented. It is determined for which of the Boolean operations of intersection, union and complementation various of the definable classes is closed. As a result, some definable classes are shown to be equal. The family of definable classes is partially ordered with respect to inclusion. It is shown that a countable number of definable classes are distinct from those of previously prosed definability conditions. Author (TAB)

N70-39713 Hawaii Univ., Honolulu.
SOME RESULTS ON ALGEBRAICALLY STRUCTURED ERROR-CORRECTING CODES
Chin-Long Chen (Ph.D. Thesis) 1969 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-16650

Three classes of error correcting codes are studied: quasi-cyclic codes, binary cyclic codes and polynomial codes. A class of maximum-length sequence codes with one digit deleted is shown to be equivalent to a subclass of majority logic decodable quasi-cyclic codes. Another subclass of quasi-cyclic codes is shown to be equivalent to the first order, generalized Reed-Muller codes. A simple scheme is derived for computing the minimum distance of cyclic codes. Minimum distances found by putting this scheme on a digital computer are given for all binary cyclic codes of length less than or equal to 65. Several cyclic codes of length 63 are found to be better than BCH codes. A simple algebraic proof of the minimum distance of these codes is given. Also, a method calculating the BCH minimum distance bound of cyclic codes is derived. A type of product code which is the product of two BCH codes is investigated by polynomial approach. Dissert. Abstr.

N70-39720*# Columbia Univ., New York. Dept. of Electrical Engineering.
COMPUTATIONAL METHODS FOR DIGITAL SIMULATION OF CONTINUOUS SYSTEMS
Richard A. Di Perna Jun. 1970 120 p refs
(Grants NGR-33-008-090; NSF GK-2283)
(NASA-CR-113571; TR-123) Avail: NTIS CSCL 09B

The methods are applicable to a wider class of systems and are more efficient than the methods used in currently available simulation languages. Two fundamentally different approaches to simulation are distinguished and described, and the characteristics of the simulation which result from using these methods are investigated. Two serious limitations of available simulation languages are their inability to solve sets of implicit equations and to deal efficiently with stiff systems. Methods suitable for the efficient handling of stiff systems are developed within the framework of the two approaches to simulation. It is shown that these methods yield implicit equations for the overall simulation. In order to structure simulation languages to deal with implicit equations, sorting, and iteration procedures for the efficient solution of these equations are presented. Author

N70-39758# Sandia Corp., Livermore, Calif.
COMPUTER DETECTED ERRORS IN THE ASTM X-RAY POWDER DIFFRACTION FILE
M. C. Nichols Apr. 1970 26 p ref
(Contract AT(29-1)-789)
(SCL-DR-70-48) Avail: NTIS

Minor deficiencies, inconsistencies, and errors have been discovered on the ASTM X-ray Powder Diffraction File as distributed on magnetic tape. Results indicate that these inaccuracies were derived from: (a) the literature itself, (b) the transfer of data from the literature to the ASTM 3 × 5 file cards, and (c) the transfer

of information from the 3 × 5 file cards to the magnetic tape. The errors discovered are included, together with suggestions for both correcting the inconsistencies and omissions found on the 3 × 5 cards and on the magentic tape version of the file, and for implementing a computer program to detect future inconsistencies and omissions. Author (NSA)

N70-39792*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ASTRIONICS DIVISION
In its Space Programs Sum. No. 37-63, vol. 3 30 Jun. 1970 p 150–160 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 09B

Software for the self-testing and self-repairing spacecraft computer comprises three types of programs: (1) the first type is used to prepare programs to be run by STAR computer; (2) the second type executes aids; and (3) the third is used in subroutines or special purpose programs. An invariant feature extraction algorithm is used as input for a statistical classifier in pattern recognition problems for characters of the English language. G.G.

N70-39837*# Oak Ridge National Lab., Tenn. Neutron Physics Div.
THE INFORMATION ANALYSIS CENTER CONCEPT AS DEVELOPED BY THE RADIATION SHIELDING INFORMATION CENTER IN ITS COMPUTER CODES ACTIVITIES
B. F. Maskewitz, D. K. Trubey, H. E. Comolander, H. R. Hendrickson, I. J. Brown et al 28 Apr. 1970 44 p refs Presented at the Semiann. USAEC Computer Conf., Washington, D.C., 30 Apr.–1 May 1970 Sponsored in part by AEC
(Contract NASw-1812)
(NASA-CR-113400; PB-191284; ORNL-TM-2973) Avail: NTIS CSCL 05B

In implementing the information analysis center concept of acquiring, analyzing, and synthesizing a body of information, the radiation shielding information center packages and distributes computer codes. These codes, used for calculating radiation transport, solving related problems, or processing needed data, are used by scientists and engineers in research or shield design work for government and industry. A description is given of the objectives, scope, recent accomplishments, and auxiliary activities of the center. A brief summary of the available codes is also given. Author (USGRDR)

N70-39856# Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
MANUAL OF APL/500 FUNCTIONS
Henry T. Lippert, Edward V. Harris, David B. Thomas, and Thomas D. McMurchie 15 Jun. 1970 61 p
(Contract N00014-68-A-0494)
(AD-708036; Memo-3) Avail: NTIS CSCL 9/2

The manual of APL functions contains an organizational taxonomy for the manual, the identification scheme for individual functions and instructions for use of the directory on the Florida State University APL 1500 system. The functions are listed in five categories: programming aids, statistical analysis, character handling, numerical, and graphics. A total of forty-four functions are documented and listed. TAB

N70-39889# Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
TELEPROCESSING: A DEC 680 INTERFACED TO AN IBM 1500
Bruce H. Freed, Harold F. O'Neil, Jr., Lloyd Lauffer, and Robert Lushene 15 Jun. 1970 46 p refs *Its* CAI Systems Memo No. 5
(Contract N00014-68-A-0494)
(AD-707705) Avail: NTIS CSCL 9/2

The report outlines the addition of a teleprocessing capability to an IBM 1500 system. As there was no cost effective way to attach remote terminals within the current framework of the IBM hardware, a DEC 680 communication system served as a basis for a designed hardware and software system for teleprocessing with the 1500 system. TAB

N70-39911# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS REVIEW, VOLUME 4, NO. 4
Wade B. Holland, ed. Apr. 1970 1970 56 p refs
(Contract F44620-67-C-0045)
(AD-708154; RM-6200/4-PR) Avail: NTIS CSCL 9/2

Featured are 3 articles by top Soviet computer scientists: V. M. Glushkov discusses trends in computer technology in 2 articles, specifically computer center organization. Leading computer designer S. A. Lebedev writes about the conversion to third-generation design techniques and large-scale integration. An article surveying solid-state technology covers such subjects as integrated circuits, elionics (electron- and ion-beam techniques), optoelectronics, dielectronics, and acoustoelectronics. An article on the ASP automated design system, which uses the M-220 computer, examines ASPs basic design stages and designer/computer interaction during mathematical modeling and machine design. Other articles consider: (1) the new Dnepr-2 control system, (2) a hybrid analog-digital system for use in physics and chemistry research, and (3) the use of activated alkali halide crystals as luminescent storage cells. TAB

N70-39912# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS REVIEW, VOLUME 4, NO. 5
Wade B. Holland, ed. May 1970 63 p
(Contract F44620-67-C-0045)
(AD-708155; RM-6200/5-PR) Avail: NTIS CSCL 9/2

Contents: Kashtan computer and USSR-GDR control system; State-wide control systems; Second all-union conference on programming; The VUM plant; Software crisis; centralized coordination needed; The philosophy of control of complex systems; LGU establishes control processes faculty; Automation falters in textile industry; Science and the modern Army; A chess-playing algorithm; Space and naval research at institute of cybernetics; Electrotablet for computer input of graphic information. TAB

N70-39988# California Univ., Livermore. Lawrence Radiation Lab.
LABORATORY COMPUTERIZATION: PROBLEMS AND POSSIBLE SOLUTIONS
Jack W. Frazer 19 May 1970 14 p Presented at the Am. Soc. for Testing and Mater. Meeting, Philadelphia, 12 May 1970 Submitted for publication Sponsored by AEC
(UCRL-72470) Conf-700518-1) Avail: NTIS

The development of good systems specifications is reported to be the first step in laboratory computerization. In effectively implementing this technology, consideration is given to the computer and I/O equipment, software functions, and documentation. Data acquisition, control, on-line computations, and a new approach to experimentation via interactive and adaptive systems are among the advantages cited. E.M.C.

N70-40029# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE LANGUAGE OF LOGIC NETWORKS
N. A. Krinitskii 5 Jun. 1970 32 p refs Transl. into ENGLISH from Teifrovaya Vychislitelnaya Tekhn. i Programmirovanie (USSR), no. 3, 1967 p 3–17
(AD-708329; FTD-HC-23-432-69) Avail: NTIS CSCL 9/2

Classical algorithmic languages cannot describe conversion processes transpiring in a series-parallel manner. The article proposes a generalized logic-network language and a generalized algorithm which can describe series-parallel conversion processes. The generalized algorithm can describe actions of one or several executives (e.g., a group of program-controlled computers). The ordinary algorithm contains two instructions: (a) to perform an operation and (b) to transfer to a certain point. The generalized algorithm may contain an instruction of transfer to several points simultaneously. Concepts of sequence, sequence ratio, compatibility, segment (generalized logic circuit), mark (combination of conjunctions and alternatives), term, reference, and pronetwork are defined. The synthesis of a network is considered as a result of execution of segment algorithms and mark algorithms. A network comprising n terms can be represented graphically as a configuration constructed with n nodes; it is equivalent to a given formula. TAB

N70-40033# Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.

DOCUMENTATION FOR THE EDIT AND DATA PREPARATION PROGRAMS

Harold F. O'Neil, Jr., Duncan N. Hansen, Bruce Freed, Eugene Webster, George W. Hogshead, III, et al 15 Jun. 1970 65 p refs *Its* CAI Systems Memo No. 1

(Contract N00014-68-A-0494)

(AD-707703) Avail: NTIS CSCL 9/2

The document was prepared for the prospective users of two additions to the Data Management System of the Florida State University Computer-Assisted Instruction Center. These two additions are the EDIT Program and the Data Preparation Program. It is assumed that the user has an operational Florida State University Data Management System for the IBM 1500/1800 system. The manual is divided into two sections, a users manual and a programmers manual. Examples of output generated by authors of CAI materials are included. However, the output of these programs is still raw data. A statistical system is needed to make descriptive or inferential statements about the data. These extensions will hopefully insure greater reliability, be user oriented and offer more flexibility of output for CAI data than the existing set of Florida State University CAI programs. Author (TAB)

N70-40049# Hawaii Univ., Honolulu.

PROBABILITIES IN CONTEXT-FREE PROGRAMMED GRAMMARS

Celso de Renna e Souza (Notre Dame Univ., Ind.) Mar. 1970 52 p refs

Contract F44620-69-C-0030; Proj. Themis)

(AD-707655; Themis-A70-2; AFOSR-70-1687TR) Avail: NTIS CSCL 9/2

Context-free programmed grammars with probabilities attached to the go-to fields are studied as realistic models for syntactical information sources. The model is formally defined and examples of its output are given. Simplifications that follow from the imposition of leftmost derivations are displayed. Source models for languages that are known to be context-free are studied, and for these a first-order Markov approximating source is obtained; standard methods are then used to calculate its entropy. Author (TAB)

N70-40051# Stanford Univ., Calif. Dept. of Computer Science.

AN OPERATOR WHICH LOCATES EDGES IN DIGITIZED PICTURES

Manfred H. Hueckel Oct. 1969 41 p refs

(Contract ARPA SD-183)

(AD-708075; SU-AIM-105) Avail: NTIS CSCL 8/4

The paper reports the development of an edge finding operator (subroutine) which accepts the digitized light intensities within a small disc-shaped subarea of a picture and yields a description of any edge (brightness step) which may pass over the disc. In addition, the operator reports a measure of the edges reliability. A theoretical effort disclosed the unique best operator which satisfies a certain set of criteria for a local edge recognizer. The main concerns of the criteria are speed and reliability in the presence of noise. Author (TAB)

N70-40058# Illinois Univ., Urbana. Coordinated Science Lab.

A STUDY OF DIGITAL NETWORK STRUCTURE AND ITS RELATION TO FAULT DIAGNOSIS

John Patrick Hayes (Ph.D. Thesis) May 1970 144 p refs

(Contract DAAB07-66-C-0199; Grant NSF GK-15459)

(AD-707691; R-467; UILU-eng-70-212) Avail: NTIS CSCL 9/2

A network model, is introduced for the study of fault diagnosis in digital logic networks. It is shown that every network can be transformed into an equivalent normal NAND network from which all the information pertaining to the diagnosis of the original network can be obtained. The use of this model greatly simplifies fault analysis and test generation. The structure of the classes of indistinguishable faults in normal NAND networks is studied. It is shown that for certain types of networks, the indistinguishability classes can be characterized in a very simple manner. The conditions under which masking can occur are examined. These conditions lead to efficient methods for generating multiple-fault detection test sets. Some general bounds for the number of tests required by a network are examined. It is proven that for a n-input fanout-free network, the cardinality of any minimal detection or location test set lies between 2(square root of n) and 2n. It is argued that a 2-level realization of a random n-variable function requires, on the average, 2 to the (n-1) power tests to detect all faults. It is shown that for certain classes of functions there exists multi-level realizations which require relatively few tests, and for which complete detection test sets can easily be generated. Author (TAB)

N70-40079*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.

THEORY AND DESIGN OF RELIABLE SPACECRAFT DATA SYSTEMS Quarterly Progress Report, 10 May – 9 Aug. 1969

29 Aug. 1969 73 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952492; Michigan Proj. 02802)

(NASA-CR-113551; QPR-2) Avail: NTIS CSCL 09B

Continuing research is reported and includes the following areas of investigation: (1) A study was made of permanent memory faults in sequential switching systems, and, in particular, the relationship between such faults and the resulting system behavior. (2) A mathematical model for studying fault-masking and fault-diagnosis in combinational networks was developed that allows a hierarchy of fault-diagnosis concepts to be defined. (3) A study of the problem of designing sequential machines with fault detecting capabilities was initiated, beginning with a classification of machines according to some machine-theoretic properties pertinent to the design of fault detecting experiments. D.L.G.

N70-40094# Hawaii Univ., Honolulu.

THE ALOHA SYSTEM: ANOTHER ALTERNATIVE FOR COMPUTER COMMUNICATIONS

Norman Abramson Apr. 1970 21 p refs

(Contract F44620-69-C-0030; Proj. Themis)

(AD-707853; THEMIS-B70-1; AFOSR-70-1686TR) Avail: NTIS CSCL 9/2

In September 1968 the University of Hawaii began work on a research program to investigate the use of radio communications for computer-computer and console-computer links. The report describes a remote-access computer system - THE ALOHA SYSTEM - under development as part of that research program and discusses some advantages of radio communications over conventional wire communications for interactive users of a large computer system.

An analysis of the random access communication method used in THE ALOHA SYSTEM is provided and it is shown that the maximum number of interactive users who can be supported by the system is about 160. Author (TAB)

N70-40110# Wisconsin Univ., Madison. Mathematics Research Center.
LECTURES ON ERROR CORRECTING CODES
H. Mann and D. K. Ray-Chaudhuri 1970 91 p *Its* Orientation Lecture Ser. 6
(Contract DA-31-124-ARO(D)-462)
(AD-707618) Avail: NTIS CSCL 9/4

Contents: Groups and fields; Group codes and vector spaces; Cyclic codes; Burst error correcting codes; Petersons decoding rule for binary Bose-Chaudhuri codes; Coding theorems of information theory; Implementation of error-correcting codes; and Majority logic decodable codes. TAB

N70-40114# Stanford Univ., Calif. Dept. of Computer Science.
THE COMPUTER REPRESENTATION OF SIMPLY DESCRIBED SCENES
Richard Paul, Gil Falk, and Jerome Feldman Oct. 1969 19 p refs
(Contract ARPA SD-183)
(AD-708072; SU-AIM-101) Avail: NTIS CSCL 6/4

The paper describes the computer representation of scenes consisting of a number of simple three-dimensional objects. One method of representing such scenes is a space oriented representation where information about a region of space is accessed by its coordinates. Another approach is to access the information by object, where, by giving the object name, its description and position are returned. As the description of an object is lengthy, it is desirable to group similar objects. Groups of similar objects can be represented in terms of a common part and a number of individual parts. If it is necessary to simulate moving an object then only the individual information need be saved. Author (TAB)

N70-40121# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRICAL DIGITAL COMPUTER
15 May 1970 16 p Transl. into ENGLISH from Elektron. Vychislitelnaya Mashina (Minsk), 1969 p 1-3
(AD-708354; FTD-HT-23-255-70) Avail: NTIS CSCL 9/2

The article introduces the new Minsk-32 computer, the most advanced of the Minsk-22 series. Besides its large memory capacity, the Minsk-32 has a number of other advantages over previous models, especially since it is compatible with the Minsk-22M electronic computer. The new computer will be used in scientific and technological problem solving, in economic planning, and in controlling commercial enterprises. Author (TAB)

N70-40125* National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
ANALOG-TO-DIGITAL CONVERSION SYSTEM Patent
Louis Mazer, inventor (to NASA) Issued 2 Nov. 1965 (Filed 13 Jul. 1962) 8 p Cl. 340-347
(NASA-Case-XAC-00404; US-Patent-3,216,007; US-Patent-Appl-SN-209801) Avail: US Patent Office CSCL 09B

A conversion system for increasing the resolution of analog-to-digital converters is described. Resolution is doubled by use of step-up gearing between the instrument or other analog device and the shaft of the converter such that the converter disk rotates twice for each full scale excursion or revolution of the instrument. A simple switch is employed to indicate which half of a revolution the instrument scale is in. Switching ambiguity in the readout is prevented by an appropriate arrangement of instrument stops and a logic circuit coupled to the converter output. R.B.

N70-40128# Stanford Univ., Calif. Dept. of Computer Science.
SPINOZA 2: CONCEPTUAL CASE-BASED NATURAL LANGUAGE ANALYSIS
Roger C. Schank, Lawrence Tesler, and Sylvia Weber Jan. 1970 112 p refs
(Contract ARPA SD-183; Grant PHS-MH-06645-09)
(AD-707739; SU-AIM-109) Avail: NTIS CSCL 5/7

The paper presents the theoretical changes that have developed in conceptual dependency theory and their ramifications in computer analysis of natural language. The major items of concern are: the elimination of reliance on grammar rules for parsing with the emphasis given to conceptual rule based parsing; the development of a conceptual case system to account for the power of conceptualizations; the categorization of ACTs based on permissible conceptual cases and other criteria. These items are developed and discussed in the context of a more powerful conceptual parser and a theory of language understanding. Author (TAB)

N70-40144# Stanford Univ., Calif. Dept. of Computer Science.
SEMANTICS IN CONCEPTUAL ANALYSIS
Roger C. Schank May 1970 59 p refs
(Contracts ARPA SD-183; PHS-MH-06645-09)
(AD-707741; AI-Memo-122) Avail: NTIS

The paper examines the question of what a semantic theory should account for. Some aspects of the work of Katz, Fillmore, Lakoff and Chomsky are discussed. Semantics is concluded to be the representation problem with respect to conceptual analysis. The beginnings of a solution to this problem are presented in the light of developments in conceptual dependency theory. Author (TAB)

N70-40152# Stanford Univ., Calif. Dept. of Computer Science.
EDGE DETECTION IN PICTURES BY COMPUTER USING PLANNING
Michael D. Kelly Jan. 1970 30 p refs
(Contract ARPA SD-183)
(AD-708068; SU-AIM-108) Avail: NTIS CSCL 6/4

The paper describes a program for extracting an accurate outline of a mans head from a digital picture. The program accepts as input digital, grey scale pictures containing people standing in front of various backgrounds. The output of the program is an ordered list of the points which form the outline of the head. The edges of background objects and the interior details of the head have been suppressed. The program is successful because of an improved method for edge detection which uses heuristic planning, a technique drawn from artificial intelligence research in problem solving. A brief, edge detection using planning consists of three steps. A new digital picture is prepared from the original; the new picture is smaller and has less detail. Edges of objects are located in the reduced picture. The edges found in the reduced picture are used as a plan for finding edges in the original picture. Author (TAB)

N70-40170# Michigan Univ., Ann Arbor.
MOMS: MICHIGAN'S OWN MATHEMATICAL SYSTEM
Robert W. Taylor, ed. Apr. 1970 170 p refs
(Contract DA-49-083-OSA-3050; ARPA Order 716)
(AD-707788; MEMO-27) Avail: NTIS CSCL 9/2

MOMS (Michigans Own Mathematical System) provides a facility for interactive, computer-aided mathematical investigations. The system runs on an IBM 360/67 under the Michigan Terminal System (MTS). An IBM 2250 Graphic Display is used for input and output. The report contains a users manual as well as detailed documentation of the system organization and resulting modules. Sections on the relation between MOMS and the operating system are also included. TAB

N70-40183# Addis Translations International, Woodside, Calif.
SYSTEM FOR DISPLAY AND FILE UPDATING OF

PERIODICALS: TECHNICAL DESCRIPTION [SYSTEME D'AFFICHAGE ET DE MISE A JOUR DU FICHIER DES PERIODIQUES]
Jun. 1969 59 p Transl. into ENGLISH from Laval Univ. Rept. Prepared for Calif. Univ., Livermore. Lawrence Radiation Lab.
(UCRL-Trans-10346) Avail: NTIS

The system is independent of the contents. It is applicable to any file composed of fewer than 10,000,000 records, of variable length limited to 127 to 255 characters, and divided into 25 fields or less. The screen check program RACINE is described. The system is written in Assembler language for an IBM 360 computer Model 30 or higher. It uses a magnetic tape, at least one disk type 2311, one control unit type 2848 and at least one display station type 2260. It operates under the control of Operation System OS/360, version 14 or later ones. The documentation is intended for programmers who might have to modify the system. Author

N70-40196# Los Alamos Scientific Lab., N.Mex.
THEORY AND USE OF THE GENERAL-GEOMETRY TWOTRAN PROGRAM
K. D. Lathrop and F. W. Brinkley Apr. 1970 80 p refs
(Contract W-7405-ENG-36)
(LA-4432) Avail: NTIS

Finite difference equations are derived for the Boltzmann transport equation in rectangular, cylindrical, and cylindrical geometries. These equations are shown to be consistent with the analytic forms of the transport equation, and when used with the arithmetic mean difference assumption, to have second-order truncation error. The TWOTRAN program to solve the multigroup approximation to the transport equation using these difference equations is described. The theory of a coarse-mesh rebalancing procedure which accelerates all the iterative processes of the program is derived. Detailed input and usage instructions for the program are given, including flow charts of the major subroutines. Functional descriptions of the major sweeps through the space-angle mesh are provided. A sample problem is described. Author (NSA)

N70-40208# International Business Machines Corp., San Jose, Calif. San Jose Research Lab.
FILE DESIGN: A PRACTICAL APPROACH. VOLUME 2: FILE ORGANIZATION MODELING SYSTEM (USERS MANUAL) Final Report
Michael E. Senko and Harriet R. Meadow Oct. 1969 83 p
(Contract F30602-69-C-0100)
(AD-707544; RADC-TR-69-392-Vol-2) Avail: NTIS CSCL 9/2

The prototype file design handbook contains extensive quantitative file design discussion. The basic foundation of the discussion is provided by tables and graphs derived from hundreds of actual machine and simulation model runs. These runs take into consideration all the complex characteristics of real-life access methods and thereby insure against oversimplified abstractions which tend to overestimate performance. The file designer can use these tables to obtain quantitative estimates of performance for analogies to his problem and to obtain general information with regard to trends and discontinuities in access method behavior. The text contains discussions of generalizations that appear to be validly derivable from the tables. Finally, in several instances, approximate equations have been provided to further quantify the generalizations for the designer. Author (TAB)

N70-40260# Oregon State Univ., Corvallis. Dept. of Oceanography.
GEOPHYSICAL DATA REDUCTION AND PLOTTING COMPUTER PROGRAMS
Michael Gemperle and Kenneth M. Keeling May 1970 118 p refs
(Contract N00014-67-A-0369-0007)
(AD-708060; TR-180) Avail: NTIS CSCL 8/5

A computer program package used to reduce and plot bathymetric, magnetic, gravimetric, and other geophysical data gathered at sea is described. The program package checks for data errors, merges geophysical data to obtain the desired output, and plots the output as profiles or on computer-generated mercator projection maps. TAB

N70-40276# MITRE Corp., Bedford, Mass.
TACTICAL AIRLIFT AUTOMATION DEVELOPMENT/TESTED EXPERIMENTATION
Duncan A. MacQueen, Jr. 2 Jun. 1970 7 p Presented at the Tactical Airlift Command and Control Panel Armed Forced Commun. and Electron. Assoc. Conv., Washington, D.C., 2 Jun. 1970
(Contract F19628-68-C-0365)
(AD-708722; ESD-TR-70-199) Avail: NTIS CSCL 9/2

The Air Force Electronic Systems Division and the MITRE Corporation have established a Tactical Data Systems Development Testbed at ESD to evaluate automation concepts for the control of tactical air operations. The testbed has been used to implement and evaluate a current operations tactical airlift capability. Author (TAB)

N70-40280# Naval Postgraduate School, Monterey, Calif.
GRAPHIC DISPLAY AND MANIPULATION OF TREE TYPE DATA STRUCTURES
Claude Myrick Holifield, Jr. (M.S. Thesis) Dec. 1969 81 p refs
(AD-709091) Avail: NTIS CSCL 9/2

The subroutine package TREEPAK is designed to interface a PL/I program with a graphic display unit, allowing display, creation and manipulation of tree structures, while providing the user with a graphic representation of the tree. Facilities include creation of trees from the alphanumeric keyboard and cards, adding and deleting subtrees in existing trees, and saving and retrieving trees. Author (TAB)

N70-40302# Maryland Univ., College Park. Computer Science Center.
BOUNDS ON THE COMPLEXITY OF GRAMMARS
James W. Snively, Jr. May 1970 76 p refs
(Contract Nonr-5144(00))
(AD-707755; TR-70-114) Avail: NTIS CSCL 9/2

In the study of the theory of image processing by computer, with emphasis on the theory of picture grammars, a problem of particular interest is that of how simple a grammar for a given language can be; a one-dimensional version of the problem is treated in the document. Three implicit measures of the complexity of a phrase structure grammar are: the length of the longest member of a rule of the grammar, the size of the vocabulary of the grammar, and the number of rules of the grammar. Upper and lower bounds on these measures are sought for grammars that generate a given language. TAB

N70-40320# Syracuse Univ., N.Y.
LARGE SCALE INFORMATION PROCESSING SYSTEMS. VOLUME 1: INVESTIGATIONS IN NATURAL LANGUAGES Final Technical Report, 15 Jul. 1967 – 15 Jan. 1970
P. L. Peterson, R. D. Carnes, I. R. Reid, and E. J. O'Connell Griffiss AFB, N.Y. RADC May 1970 144 p refs
(Contract F30602-68-C-0013)
(AD-708725; RADC-TR-70-80-Vol-1) Avail: NTIS CSCL 9/2

The report consists of five volumes containing several reports from a number of academic and research staffs investigating new approaches or new methods in the design or utilization of information processing systems, with particular emphasis on large scale digital systems. The investigations were concerned with four main areas of interest. The first is in methods for the improvement

of system effectiveness and for extending the range of applications of large scale systems, with particular emphasis on on-line, time-shared techniques for user-oriented systems. The second was investigation into the application of large scale information systems to problems in diverse areas. Primary emphasis was on problems requiring non-numeric techniques. Third was investigation into measures of efficiency, cost-effectiveness, and user reaction to various types of systems, with emphasis on system and user adaptability. Fourth was investigations in the fundamental theoretical structure of large scale systems, its component elements, and related areas of technology. Author (TAB)

N70-40321# Syracuse Univ., N.Y.
LARGE SCALE INFORMATION PROCESSING SYSTEMS. VOLUME 2: INVESTIGATIONS IN DATA MANAGEMENT Final Technical Report, 15 Jul. 1967–15 Jan. 1970
P. Atherton, K. Miller, D. Aurrichio, and H. Schwarzlander Griffiss AFB, N.Y. ADC May 1970 72 p refs
(Contract F30602-68-C-0013)
(AD-708726; RADC-TR-70-80-Vol-2) Avail: NTIS CSCL 9/2

Contents: LC/MARC on molds--an experiment in computer-based, interactive bibliographic storage, search, retrieval, and processing; SURPARS--an on-line data system; Information retrieval project. TAB

N70-40322# Syracuse Univ., N.Y.
LARGE SCALE INFORMATION PROCESSING SYSTEM. VOLUME 3: INVESTIGATIONS IN COMPUTER LANGUAGES Final Technical Report, 15 Jul. 1967–15 Jan. 1970
G. Foster, E. Stabler, H. Offek, and G. Rossmann Griffiss AFB, N.Y. RADC May 1970 145 p refs
(Contract F30602-68-C-0013)
(AD-708727; RADC-TR-70-80-Vol-3) Avail: NTIS CSCL 9/2

Contents: A programming language--Manipulation of data structures and some proposed extensions; System description languages; Microprogram transformations; Graph description language; Program schemata and microprogram transformation. TAB

N70-40323# Syracuse Univ., N.Y.
LARGE SCALE INFORMATION PROCESSING SYSTEMS. VOLUME 4: SPECIAL INVESTIGATIONS Final Technical Report, 15 Jul. 1967–15 Jan. 1970
W. Le Page, R. Prather, R. Sargent, D. Weiner, and K. Fishell et al Griffiss AFB, N.Y. RADC May 1970 134 p refs
(Contract F30602-68-C-0013)
(AD-708728; RADC-TR-70-80-Vol-4) Avail: NTIS CSCL 9/2

Contents: Computer aided instruction; A categorical verification of automata theory; Computer aided design of inventory systems; Computer generated films; Instructional applications; A note on the solution of sequential boolean equations. TAB

N70-40324# Syracuse Univ., N.Y.
LARGE SCALE INFORMATION PROCESSING SYSTEMS. VOLUME 5: STUDY OF ASSOCIATIVE MEMORY SYSTEMS Final Technical Report, 15 Jul. 1967–15 Jan. 1970
T. Feng Griffiss AFB, N.Y. RADC May 1970 335 p refs
(Contract F30602-68-C-0013)
(AD-708729; RADC-TR-70-80-Vol-5) Avail: NTIS CSCL 9/2

Contents: Associative memory system manipulations; Associative memory system organizations. TAB

N70-40330# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERAL RESEARCH Quarterly Technical Summary Report, 1 Feb.–30 Apr. 1970
Melvin A. Herlin, Herbert G. Weiss, Robert H. Kingston, John F. Hutzenlaub, and Alan L. McWhorter 22 Jun. 1970 41 p refs
(Contract AF 19(628)-5167)
(AD-708721; ESD-TR-70-96) Avail: NTIS CSCL 9/2

The report is a Quarterly Technical Summary covering the period from 1 February through 30 April 1970. It consolidates the reports of Division 2 (Data Systems), Division 5 (Optics), Division 7 (Engineering), and Division 8 (Solid State) on the General Research Program at Lincoln Laboratory. TAB

N70-40355# HRB-Singer, Inc., State College, Pa.
AN "OPTIMIZER" FOR USE IN COMPUTER SIMULATION: BACKGROUND AND DESIGN
Dennis E. Smith Jul. 1970 70 p refs
(Contract N00014-69-C-0285)
(AD-708765; HRB-4352-11-R-1) Avail: NTIS CSCL 9/2

Computer simulation has many advantages. However, one major disadvantage is that, in all too many cases, the attempt to use computer simulation to find an optimum solution to a problem rapidly degenerates into a trial-and-error process. This disadvantage, which has, unfortunately, received relatively little attention in the literature, is addressed in the present study. Techniques for overcoming this disadvantage, i.e., for making optimization and computer simulation more compatible, are applicable at two points in the development of the overall computer simulation. Techniques which are used within actual construction of the mathematical models comprising the simulation will be labeled as internal methods, while those which are used after the simulation has been completely developed will be termed external methods. The report briefly discusses various internal and external methods, concludes that the largest potential payoff in the area of optimization will be from external methods, and suggests the development of an Optimizer computer program of wide applicability which could be coupled to existing simulations. The Optimizer based on external methods, would use the inputs and outputs of the simulation plus additional information from the simulation user to automate, to a degree, the optimization process and, hopefully, provide a great improvement over trial-and-error. Author (TAB)

N70-40369# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.
ESP ECHELONED SERIES PROCESSOR
Arnold Rom May 1970 35 p refs
(AD-708808; D1-82-0976) Avail: NTIS CSCL 9/2

An Echeloned Series Processor (ESP) has been implemented on a computer. The processor has certain similarities with MAO (MAO is a processor for Poisson series). Echeloned Series contain divisors in literal form. List processing and dynamic storage techniques are used to handle Echeloned Series by computer. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N70-39327# ITT Federal Support Services, Inc., Richland, Wash. Electrical System Maintenance.
MOISTURE PROBLEMS IN MAGNETIC AIR CIRCUIT BREAKERS
G. A. Zeitler [1970] 6 p Presented at the Doble Eng. Co. Ann. Clients' Conf., Boston

(Conf-700413-1) Avail: NTIS

A feeder breaker, serving a motor load out of the 151-H primary substation, is investigated. Studies indicated that the arc chutes had not only failed to quench the arc, but appeared to have caused the arc to expand and flash over phase-to-phase and phase-to-ground, even into the linkage and structural parts. In rehabilitating the breakers at the 151-H substation, the following procedures were established: (1) Arc chutes shall be dried in the disassembled state in an oven at 185 F until the bushing and associated insulation losses at room temperature measure between 0.20 and 0.30 watts, and the losses of the arc chutes between the breaker contacts are below 0.60 watts. (2) Refinish or replace all damaged side plates and supports. Author

N70-39464*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FLAT CONDUCTOR FOR LIMITED ROTARY OR LINEAR MOTION
James R. Carden Oct. 1970 27 p
(NASA-TM-X-53960) Avail: NTIS CSCL 09A

The capabilities and limitations of flat conductor cable (FCC) relative to bending, flexing, and folding are described. These characteristics are exemplified in various applications which show how electrical connection is maintained between equipment units during linear and/or rotary movement of such units relative to each other. The flexibility characteristics are exemplified by the typical FCC configurations shown. Information concerning bending and torque characteristics of FCC, is presented and illustrated with charts, graphs, and other data. Author

N70-39536*# Stanford Research Inst., Menlo Park, Calif.
AVALANCHE-DIODE OSCILLATOR CIRCUIT WITH TUNING AT MULTIPLE FREQUENCIES Quarterly Technical Report, 4 Mar. – 4 Jun. 1970
Don Parker 16 Jun. 1970 40 p refs
(Contract NAS12-2231)
(NASA-CR-113591; QTR-2) Avail: NTIS CSCL 09E

The operating characteristics of an avalanche diode oscillator are determined for the case when several currents, harmonically related, are flowing in the diode. The design, contruction, and testing of an avalanche diode circuit that will permit independent tuning of three harmonically related frequencies are discussed. Author

N70-39551# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
PRECISION MEASUREMENT AND CALIBRATION. VOLUME 4: ELECTRICITY-RADIO FREQUENCY
Arthur J. Estin, ed. Jun. 1970 352 p refs
(NBS)-Spec-Publ-300-Vol-4) Avail: SOD $5.50

Reprints of articles are presented on radio frequency electrical measurements covering the following topics: power, sinusoidal voltage and current, electromagnetic fields and antennas, radar and baseband pulses, noise, attentuation and phase, impedance, radio frequency materials, quasi-optics and millimeter waves, and applications to measurement systems. For individual titles see N70-39552 through N70-39602.

N70-39552# National Bureau of Standards, Boulder, Colo.
RADIO FREQUENCY POWER MEASUREMENTS
Anne Y. Rumfelt and Lyman B. Elwell *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 1–14 refs (See N70-39551 22-09)
Avail: SOD $5.50

The need for improved accuracy in radio frequency power measurement is discussed. The basic principles of bolometric, calormetric, and certain other types of power meters are reviewed. The methods for making accurate RF power measurements are discussed in detail. Emphasis is given to the techniques for eliminating or accounting for the errors due to mismatch dc or LF substitution, and bolometer mount efficiency. Author

N70-39553# National Bureau of Standards, Boulder, Colo.
A BOLOMETER MOUNT EFFICIENCY MEASUREMENT TECHNIQUE
G. F. Engen *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 16–27 refs *In its* Paper No. 65C2-62 (See N70-39551 22-09)
Avail: SOD $5.50

In the measurement of microwave power by means of the bolometric technique, the efficiency of the bolometer mount must be measured and applied as a correction in order to meet accuracy requirements. An impedance technique of determining this efficiency based on the reflectometer concept is described. A feature of the method is its substantial independence of connector discontinuity which has been a particularly troublesome source of error in coaxial impedance technique, the method is applicable to both matched and unmatched mounts and does not require mathematical approximations (in the first order theory). A comprehensive error analysis indicates that an accuracy of 0.5 percent is possible in the existing state of the art. Author

N70-39554# National Bureau of Standards, Boulder, Colo.
A DC-RF SUBSTITUTION ERROR IN DUAL ELEMENT BOLOMETER MOUNTS
Glenn F. Engen *In its* Prevision Meas. and Calibration, Vol. 4 Jun. 1970 p 28–34 refs (See N70-39551 22-09)
Avail: SOD $5.50

The error occurs when the sum of the two bolometer resistances, but not their individual values are constant. The error is determined primarily by differences in the characteristics of the bolometer elements and by assymetry in the bolometer mount. It is proposed that the RF dissipation in thermistor mounts be limited to a nominal 25 to 30% of the total power to control the error. Author

N70-39555# National Bureau of Standards, Boulder, Colo. Radio Standards Engineering Div.
COAXIAL POWER METER CALIBRATION USING A WAVEGUIDE STANDARD
Glenn F. Engen *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 35–46 refs *Its* Paper No. 70C2-223 (See N70-39551 22-09)
Avail: SOD $5.50

The techniques associated with the calibration of one terminating type power meter in terms of a second terminating meter are useful both in calibration measurements and in the practical application of such devices. The techniques assume a variety of forms but their application to the calibration transfer problem between power meters with differeint input waveguides is inhibited by the requirement of an adaptor and the uncertainty which is losses can introduce into the procedure a method is described for existing technqiues to the more general problem, in which the adaptor losses are only a second order effect and limits for the error which is introduced. Author

N70-39556# National Bureau of Standards, Boulder, Colo. High Frequency Electrical Standards Lab.
A DUAL-LOAD FLOW CALORIMETER FOR RF POWER MEASUREMENT TO 4 GHz
M. L. Crawford and P. A. Hudson *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 47–53 refs *Its* Paper No. 71C2-250 (See N70-38551 22-09)
Avail: SOD $5.50

A dual-load flow coaxial calorimeter power meter, designed for use as a reference standard and with a frequency range up to 4 GHz and beyond is described. The power range extends from 2 to 100w with an error limit of 0.38 percent. Design details, error analysis, and results of intercomparison with other standards are given. Author

N70-39557# National Bureau of Standards, Boulder Colo.
VOLTAGE MEASUREMENT AT HIGH AND MICROWAVE FREQUENCIES IN COAXIAL SYSTEMS
M. C. Selby *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 57–62 refs (See N70-39551 22-09)
Avail: SOD $5.50

The progress and current state-of-the-art in measuring voltages at frequencies to 10 GHz and higher is described. The trend towards higher frequencies in voltmeter design is indicated. Advantages of voltage measurements and standards over computation of voltages from power and impedance measurements are discussed. Some pending development problems are indicated and major steps are proposed to improve the application of voltmeters at frequencies above 30 MHz. Author

N70-39558# National Bureau of Standards, Boulder, Colo.
THE MEASUREMENT OF CURRENT AT RADIO FREQUENCIES
Winston W. Scott, Jr. and Nolan V. Frederick *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 63–88 refs (See N70-39551 22-09)
Avail: SOD $5.50

The state-of-the-art of radio frequency current measurement is reviewed with emphasis on the most useful standards. Thermocouple and electrodynamic ammeters are discussed in detail. Reference is made to current-measuring apparatus. Extensive referencing is included for investigators interested in an intensive review of radio frequency current measurements. Author

N70-39559# National Bureau of Standards, Boulder, Colo.
A PRECISION CURRENT COMPARATOR
C. McKay Allred and Robert A. Lawton *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 62–72 refs (See N70-39551 22-09)
Avail: SOD $5.50

A technique capable of precise comparison of currents in different parts of a network or between currents in different networks is discussed. With proper conditions, the comparison can be done with negligible perturbation of the networks under measurements. Experiments on a coaxial system at 30 MHz are discussed. Author

N70-39561# National Bureau of Standards, Boulder, Colo.
NBS FIELD-STRENGTH STANDARDS AND MEASUREMENTS (30 Hz TO 1000 MHz)
Frank M. Greene *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 85–96 refs (See N70-39551 22-09)
Avail: SOD $5.50

A description is given of the CW field strength standards and associated measurement instrumentation and techniques used for calibration of both commercial and military field strength meters in various frequency bands of the overall range from 30 Hz to 1000 MHz. The techniques are applicable only for evaluating the strength of steady-state, ac fields varying sinusoidally in time, and are not intended for use in broadband applications. Two principal types of field strength standards and a prototype near-zone field strength meter are described: (1) magnetic field strength standards (30 Hz to 30 MHz) (2) electric field strength standards (30 to 1000 MHz), and (3) near-zone electric field strength meter and interim field strength standards (150 kHz to 30 MHz). Author

N70-39562# National Bureau of Standards, Boulder, Colo.
FIELD STRENGTH CALIBRATION TECHNIQUES AT THE NATIONAL BUREAU OF STANDARDS
Harold E. Taggart *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 97–103 refs (See N70-39551 22-09)
Avail: SOD $5.50

The techniques and instrumentation utilized by the National Bureau of Standards to calibrate field strength meters and standards in terms of absolute field strength at frequencies from 10 kHz to 1 GHz are described. Two basic techniques are used: (1) the standard field method for loop antennas at frequencies from 30 kHz to 30 MHz and (2) the standard antenna method for horizontally polarized dipole antennas at frequencies from 30 to 1000 MHz. The accuracy and the limitations of each technique are discussed. The instrumentation used to calibrate the field strength receiver characteristics is described. Future plans of the National Bureau of Standards field strength and noise calibration services are discussed. Improved uncertainties and extended services are planned for antennas from 30 Hz to 1000 MHz. Author

N70-39563# National Bureau of Standards Boulder, Colo. Radio Standards Engineering Div.
A NEW NEAR-ZONE ELECTRIC-FIELD-STRENGTH METER
Frank M. Greene *In its* Precision Meas. and Calibration, vol. 4 Jun. 1970 p 104–110 *Its* Paper No. 71C1-443 refs (See N70-39551 22-09)
(DASA Order HD-1102-3171-0001)
Avail: SOD $5.50

Prototype instrumentation intended for use in evaluating hazards of high-level electromagnetic radiation to electroexplosive ordanance devices at military installations is described. The measuring range is from 0.1 to 1000 V per meter, at frequencies from 150 kHz to 30 MHz, with a present uncertainty of less than + or − 2 db. The design of the meters is based on a novel form of telemetry, which involves the use of a completely nonmetallic electrical transmission line over which the field information is transmitted from the measuring antennas to a remote readout unit. The line is essentially transparent to the field being measured, and reduces the perturbation of the field two orders of magnitude below that normally experience when using a metallic line. The high line loss involved necessitates miniaturizing the Rf portions of the receiving and calibrating instrumentation and placing them and their associated battery supplies inside the measuring antenna. The design and performance of the meters are discussed in detail. Author

N70-39564# National Bureau of Standards, Boulder, Colo.
THE MEASUREMENT OF BASEBAND PULSE RISE TIMES OF LESS THAN 10 TO THE MINUS 9th POWER SECOND
N. S. Nahman *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 115–124 refs (See N70-39551 22-09)
Avail: SOD $5.50

The measurement of fractional nanosecond pulse rise time is discussed, including the following subjects: oscillographic systems, pulse comparison techniques, a basic instrumentation system, and the distortion of pulses by transmission lines. A delineation of equivalent-time oscillographic sampling systems and a classification into three sampling categories, sequential, random, and multiple are included. Single transient oscillographic systems employing either traveling-wave deflection structure cathode ray tubes or multiple sampling methods are also considered. In order to clearly present the rise-time limitations caused by TEM transmission lines, attention is given to the distortion incurred by pulses upon passing through such lines. Author

N70-39565# National Bureau of Standards, Boulder, Colo.
PEAK PULSE VOLTAGE MEASUREMENT (BASEBAND PULSE)

A. R. Ondrejka *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 125–128 refs (See N70-39551 22-09)
Avail: SOD $5.50

Several methods are discussed for the measurement of pulse voltage. Oscilloscopes are particularly useful because they provide information concerning the shape of the pulse, besides a measure of the peak voltage. In addition to the oscilloscope, several peak voltmeter circuits are mentioned, including pulse stretching sampling, and the sideback method. A standard pulse generator is described which provides a calibrated pulse voltage suitable for volunteer calibration and other uses. Author

N70-39566# National Bureau of Standards, Boulder, Colo.
MEASUREMENT OF RF PEAK PULSE POWER
Paul A. Hudson *In its* Precision Meas. and Calibration, vol. 4 Jun. 1970 p 129–133 refs (See N70-39551 22-09)
Avail: SOD $5.50

The principal methods developed for the measurement of RF peak pulse power are reviewed. The basic principles involved for each method are described together with accuracies attainable under normal operating conditions. General techniques for pulse power measurement and precautions to be observed are also given. Author

N70-39567# Westinghouse Electric Corp., Baltimore, Md. Molecular Electronics Div.
ANALYSIS AND PERFORMANCE OF SUPERCONDUCTIVE COAXIAL TRANSMISSION LINES
R. J. Allen and N. S. Nahman *In* NBS Precision Meas. and Calibration, Vol. 4 Jun p 134–141 refs Prepared in cooperation with Kansas Univ., Lawrence (See N70-39551 22-09)
Avail: SOD $5.50

The mechanism affecting metallic conduction and dielectric properties in relation to a low temperature transmission line are discussed to provide a basis of analysis of the characteristics change and the remaining losses at low temperature. Specific attention is given to lines employing Teflon or polyethylene as dielectrics, and operating up to 10 GHz. The construction and measured performance of a number of long superconductive coaxial lines is given in support of the analytical results. Author

N70-39568# Kansas Univ., Lawrence. Electronics Research Lab.
NANOSECOND RESPONSE AND ATTENUATION CHARACTERISTICS OF A SUPERCONDUCTIVE COAXIAL LINE
N. S. Nahman and G. M. Gooch *In* NBS Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 142–146 refs (See N70-39551 22-09)
(Contracts DA-49-170-SC-2618; DA-18-119-SC-899)
Avail: SOD $5.50

A miniature superconducting coaxial line is described which transmits nanosecond (nsec) pulses without any measurable change in rise time. Data on the temperature dependence of the bandwidth over the range 293 to 4.2 K are presented. The investigation is confined to ten and hundred foot lengths of cable. Author

N70-39569# National Bureau of Standards, Boulder, Colo. Radio Standards Engineering Div.
MEASUREMENT STANDARDS FOR LOW AND MEDIUM PEAK PULSE VOLTAGES
A. R. Ondrejka and P. A. Hudson *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 147–152 refs *Its* Paper No. 70C1-216 (See N70-39551 22-09)
Avail: SOD $5.50

Two systems are described for the measurement and standardization of peak pulse voltage. Designed for use with pulses having durations as short as 10 nanoseconds, the systems represent initial efforts to establish standards in the field. One of the systems is a refined, slideback voltmeter employing a solid state diode. The rise time is less than 10 nanoseconds and the instrument is useful for measurements in the range 5 to 100V as presently constructed. The second system standardizes the output peak voltage level of pulse generators by means of cascaded zener diodes. The clipping level of the diodes is determined first by dc voltage measurements and the system is subsequently used to generate pulses of known peak amplitudes. The rise time of the diodes is approximately 30 nanoseconds. Author

N70-39571# National Bureau of Standards, Boulder, Colo.
A PRECISION NOISE SPECTRAL DENSITY COMPARATOR
C. M. Allred *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 170–177 refs *Its* Paper No. 66C4-108 (See N70-39551 22-09)
Avail: SOD $5.50

The theory is given for a precision comparator that measures the ratio of two noise spectral densities. The relative error of a single measurement is also derived. The comparator described removes or alleviates many of the problems in high-speed switching, and since the instrument operates under null conditions, the null position is essentially independent of amplifier noise and gain instabilities. Author

N70-39572# National Bureau of Standards, Boulder, Colo.
A PRECISION NOISE-POWER COMPARATOR
M. G. Arthur, C. M. Allred, and M. K. Cannon *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 178–182 ref (See N70-39551 22-09)
Avail: SOD $5.50

Operating at 3 MHz, it is a null-type instrument, the principal components of which are a hybrid four-port, a stable CW generator, a precision attenuator, a dual-channel amplifier and band-pass filter, and an analog multiplier. No rapid switching of the noise power or reference voltage is performed. The instrument can compare noise powers having effective noise temperatures in the range from below liquid-nitrogen temperature to greater than 30,000 K. Two noise generators having known spectral densities are used to calibrate the comparator. The uncertainty of comparison is less than 1 per cent at 75 K and decreases to 0.2 per cent at 29,000 K. Author

N70-39575# National Bureau of Standards, Boulder, Colo.
RF ATTENUATION
David Russell and Wilbur Larson *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 208–225 refs (See N70-39551 22-09)
Avail: SOD $5.50

A tutorial review of RF attenuation measurement methods and standards is presented. Accepted and proposed definitions and attenuator models are discussed. Commonly used standards operating from dc through most waveguide bands are compared with the ideal interlaboratory standard. Characteristics of fixed resistive, waveguide below-cutoff, and rotary-vane standards are included. Measurement methods are classified and described, including comments concerning the convenience and accuracy of various methods. Author

N70-39576# National Bureau of Standards, Boulder, Colo.
UHF AND MICROWAVE PHASE-SHIFT MEASUREMENTS
Doyle A. Ellerbruch *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 206–234 refs (See N70-39551 22-09)
Avail: SOD $5.50

The state-of-the-art of differential phase-shift measurements at UHF and microwave frequencies is reported. Differential

phase-shift standards, measurement techniques, and measurement uncertainties are discussed. Technical criteria to be considered when selecting a standard or a measurement system are given and techniques for minimizing the limits of uncertainty are included. A bibliography is included to supplement the general discussion. Author

N70-39577# National Bureau of Standards, Boulder, Colo.
EFFECTS OF CONNECTORS AND ADAPTERS ON ACCURATE ATTENUATION MEASUREMENTS AT MICROWAVE FREQUENCIES
Robert W. Beatty *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 236–248 refs (See N70-39551 22-09)
Avail: SOD $5.50

A source of error in microwave attenuation measurements, not previously evaluated, is treated in an original analysis. The error is caused by effects of deviations of connectors or adapters from standard specifications. In the analysis, an attenuator installed in a system is represented by three cascaded two-ports, the central one representing the core or kernel of the attenuator, and the others representing connector pairs. Three general cases are considered: the waveguide component under test has (1) either sexless or mating connectors, (2) nonmating connectors of the same type and sex, or (3) nonmating connectors of different types. The results indicate that significant errors are possible with present connectors, such as the type N, but that these types of errors become negligible when high-precision connectors are used. The analysis permits evaluation of connector efficiency for a specific attenuator application. Author

N70-39579# National Bureau of Standards, Boulder, Colo.
A MODULATED SUB-CARRIER TECHNIQUE OF MEASURING MICROWAVE ATTENUATION
G. E. Schafer and R. R. Bowman *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 255–258 refs Presented at Conf. on Microwave Meas. Tech., 7 Sep. 1961 (See N70-39551 22-09)
Avail: SOD $5.50

A method of measuring microwave attenuation is proposed which has the disadvantages of IF substitution method with single sideband operation. However, ordinary amplitude modulation is used, and neither the carrier nor one of the sidebands needs to be suppressed. Two versions of this method are described and some operational hints are given. One of the versions is capable of high accuracy with commercially available equipment. The proposed method was tested by measuring the relative attenuation of a microwave variable attenuator at 9.3897 GHz, attaining a precision of 0.0001 db at 0.01 db and 0.2db at 50 db. The measurements are compared with measurements performed by other methods. A special comparison with values obtained from dc substitution techniques was made in which environmental effects were largely eliminated. Factors affecting the accuracy of measurements made by this technique are discussed. Some of the precautions necessary to attain high accuracy are given. Author

N70-39580# National Bureau of Standards, Boulder Colo. Radio Standards Engineering Div.
A 2:1 RATIO INDUCTIVE VOLTAGE DIVIDER WITH LESS THAN 0.1 PPM ERROR TO 1 MHz
Cletus A. Hoer and Walter L. Smith *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 259–267 refs *Its* Paper No. 71C2-249 (See N70-39551 22-09)
Avail: SOD $5.50

A simple ratio transformer having a 2:1 ratio of input voltage to output voltage can be made with a ratio error less than 0.1 ppm from 1 kHz to above 1 MHz. Applications and sources of error are discussed. Experimental results leading to an optimum transformer design are given. A bridge to measure the ratio error to 0.025 ppm from 1 kHz to 1MHz is also described. Author

N70-39581# National Bureau of Standards, Boulder, Colo.
A PRECISION RF ATTENUATION CALIBRATION SYSTEM
C. M. Allred and C. C. Cook *In its* Precision Meas. and Calibration, Vol. 4, Jun. 1970 p 268–274 refs Presented at Conf. on Std. and Electron Meas. (See N70-39551 22-09)
Avail: SOD $5.50

The system discussed operates at 30 MHz, but similar systems under construction are designed to operate at other frequencies. Choosing a single frequency of operation allows designs that increase the stability, extend the measuring range, lessen the problems of leakage, and enhance the overall accuracy. Author

N70-39583# National Bureau of Standards, Boulder, Colo.
IMPEDANCE MEASUREMENTS AND STANDARDS FOR UNICONDUCTOR WAVEGUIDE
Robert W. Beatty *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 288–296 refs (See N70-39551 22-09)
Avail: SOD $5.50

A review is presented of the measurement if impedance and reflection coefficient uniconductor waveguide. Normalized impedance in a waveguide operating in a particular mode is defined and related to measured quantities such as the reflection coefficient and the VSWR. Emphasis is given to the rectangular waveguide operating in its dominant mode and to the tuned reflectometer as an instrument for achieving the most accurate results. The evolution of the tuned reflectometer at NBS is outlined and recent techniques are discussed. Different types of standards, of reflection coefficient are described and the advantages and limitations of each are mentioned. Author

N70-39584# National Bureau of Standards, Boulder, Colo.
IMPEDANCE MEASUREMENTS IN COAXIAL WAVEGUIDE SYSTEMS
R. L. Jesch and R. M. Jickling *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 297–308 refs See N70-39551 22-09)
Avail: SOD $5.50

Impedance measurements and standards in coaxial waveguide systems propagating a TEM wave are reviewed. The development of coaxial air lines as impedance standards, representative measurement methods, and the errors and measurement techniques of the slotted line in detail are discussed. Author

N70-39585# National Bureau of Standards, Boulder, Colo.
LUMPED PARAMETER IMPEDANCE MEASUREMENTS
L. E. Huntly and R. N. Jones *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 309–320 refs (See N70-39551 22-09)
Avail: SOD $5.50

The measurement of impedance in lumped circuits at radio frequencies is discussed. A brief background with particular emphasis upon the important recent development of precision coaxial connectors and coaxial air dielectric tranmission lines as immittance standards is includes. Special emphasis is given to precision coaxial connectors and their necessity in achieving highest accuracies. Standards, techniques of measurement, and instrument are considered. The present state-of-the-art is presented in graphical form wherein the accuracies attainable by best practices are compared with the best capabilities found in specifications for commercial instruments. The state-of-the-art presentation includes two-terminal as well as three-terminal measurements. Author

N70-39586# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
A GUIDE TO THE USE OF THE MODIFIED REFLECTOMETER TECHNIQUE FO VSWR MEASUREMENT
Wilbut J. Anson *In its* Precision Meas. and Calibration, Vol. 4

Jun. 1970 p 321–327 refs *Its* Paper No. 65C4-74 (See N70-39551 22-09)
Avail: SOD $5.50

The theory of the modified reflectometer technique of measuring VSWR at microwave frequencies is discussed briefly, the operational procedure is outlined, and selected results are given of an error analysis. Details essential to the use of this technique and procedural suggestions that grew out of extensive experience with the technique are included. The error analysis provides the means to evaluate the accuracy of any particular measurement made with this sytem. Author

N70-39587# National Bureau of Standards, Boulder, Colo. Radio Standards Engineering Div.
PRECISE REFLECTION COEFFICIENT MEASUREMENTS WITH AN UNTUNED REFLECTOMETER
W. E. Little and D. A. Ellerbruch *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 328–331 refs *Its* Paper No. 70C3-227 (See N70-39551 22-09)
Avail: SOD $5.50

The precision tuned reflectometer technique of reflection coefficient measurement is, at present, the most accurate technique available. Utilization of the technique requires the use of tuners and sliding terminations to eliminate or reduce the inherent errors of a directional coupler. A reflection coefficient measurement technique that approaches the accuracy of the tuned reflectometer is described. Instead of tuners, the technique uses an ideal one-quarter wavelength waveguide section to eliminate the measurement error introduced by finite directional coupler directivity and to reduce to second order the error introduced by an equivalent generator mismatch. A comparison of the quarter-wave technique with the tuned reflectometer technique through the measurement of the reflection coefficient of three 9/16 inch coaxial waveguide terminations is also included. Author

N70-39588# National Bureau of Standards, Boulder, Colo.
MEASUREMENT OF REFLECTIONS AND LOSSES OF WAVEGUIDE JOINTS AND CONNECTORS USING MICROWAVE REFLECTOMETER TECHNIQUES
R. W. Beatty, G. F. Engen, and W. J. Anson *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 332–340 refs Presented at 1960 Conf. on Std. and Electron. Meas. (See N70-39551 22-09)
Avail: SOD $5.50

The improved microwave reflectometer techniques for determining small losses and reflections are described and discussed. The VSWR and efficiency determinations, and supplemental techniques in VSWR determination are given. The techniques are applicable to waveguides with rectangular, coaxial, or any kind of cross section. N.E.N.

N70-39589# National Bureau of Standards, Boulder, Colo.
MEASURING IMPEDANCE THROUGH AN ADAPTER WITHOUT INTRODUCING ADDITIONAL ERROR
R. W. Beatty *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 340 refs (See N70-39551 22-09)
Avail: SOD $5.50

The use of the tuned reflectometer to avoid errors is described. In the process of adjusting the tuners of the reflectometer in the usual way, the reflections introduced by the addition of the adapter are tuned out. In addition, this tuning process compensates for the effect of dissipative losses in the adapter. The capability is illustrated by an example in which the main part of the tuned reflectometer is composed of rectangular waveguide components, but the one-port device has a type-N coaxial connector. In single frequency, high precision measurements, the technique seems preferable, whereas evaluation of an adapter might be worthwhile if swept frequency measurements over a broadband are required. Author

N70-39590# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
AN AUTOMATIC METHOD FOR OBTAINING DATA IN THE WEISSFLOCH-FEENBERG NODE-SHIFT TECHNIQUE
Robert W. Beatty *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 341 refs (See N70-39551 22-09)
Avail: SOD $5.50

The node-shift technique is used in the evaluation of properties of 2-ports such as those representing discontinuities in coaxial lines, for example. In the application of this technique, one locates a sliding short-circuit in the line or waveguide on one side of the 2-port under test, and connects a slotted line to the other side. The data to be obtained consist of the displacements d of a node in the standing wave pattern in the slotted line, corresponding to given displacements s of the short circuit. Plots of d vs s or (d−s) vs s show a cyclical variation repeating every half wavelength. The amplitude of this cyclical variation is a measure of the amplitude of the reflection from the discontinuity in the section of line represented by the 2-port. The speed of obtaining data by this method makes possible more extensive and thorough investigations within a given time. Author

N70-39591# National Bureau of Standards, Boulder, Colo.
MEASUREMENT OF RF PROPERTIES OF MATERIALS: A SURVEY
G. E. Bussey *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 347–354 refs (See N70-39551 22-09)
Avail: SOD $5.50

Magnetic permeability and electric permittivity measurements are reviewed from the viewpoint of radio and communications applications. When it is feasible and the state of development warrants it, a discussion of errors is given. Of special interest is how these measurements depend upon the state of development of basic RF measurements, such as attenuation and impedance. References for the standard configurations widely used for dielectric and magnetic measurements are given. Author

N70-39592# National Bureau of Standards, Boulder, Colo.
EQUATIONS FOR THE RADIOFREQUENCY MAGNETIC PERMEAMETER
Cletus A. Hoer and Alvin L. Rasmussen *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 355–362 refs *Its* Paper No. 67C1-121 (See N70-39551 22-09)
Avail: SOD $5.50

The RF permeameter is an impedance transformer for measuring toroidal-shaped magnetic materials at radiofrequencies. The permeameter is represented by its equivalent T-network and exact solutions for the permeability and dissipation factor are obtained in terms of the input impedances and the impedance of a calibration core. The resulting equations are valid for all values of permeability and dissipation factor for the conditions discussed. Values of permeability and dissipation factor calculated from these exact equations are compared with those calculated from previous equations, and these results, to 50 Mc/s and several orders of magnitude, are shown graphically. A frequency range from 0.1 to 50 Mc/s and a dissipation factor range from 0.0005 to 5 are covered. Author

N70-39593# National Bureau of Standards, Boulder, Colo.
PARALLEL REVERSIBLE PERMEABILITY MEASUREMENT TECHNIQUES FROM 50 kc/s TO 3 Gc/s
Cletus A. Hoer and R. D. Harrington *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 363–369 refs Sponsored in part by Navy Dept. *Its* Paper No. 467C3-137 (See N70-39551 22-09)
Avail: SOD $5.50

Techniques using dc fields parallel to the RF fields in toroidal

specimens are described. In the 50 kc/s to 50 Mc/s range, emphasis is directed towards recent improvements in the RF permeameter. For measurements in the 50 Mc/s to 100 Mc/s range, the feasibility of using variable length reentrant cavities with quarter wavelength chokes is demonstrated. Two half-wave variable length cavities are described for obtaining reversible permeability data in the 100 Mc/s to 3000 Mc/s range. A technique for avoiding the use of the quarter wavelines for isolating the dc and RF circuits in these half-wave cavities is emphasized and represents a definite improvement over corresponding slotted line methods. Author

N70-39594# National Bureau of Standards, Boulder, Colo.
MEASUREMENT AND STANDARDIZATION OF DIELECTRIC SAMPLES
H. E. Bussey and J. E. Gray *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 370–373 refs (See N70-39551 22-09)
Avail: SOD $5.50

The selection of a material suitable for use as a standard of dielectric properties at microwave frequencies is discussed, and tests are described which indicate that a glass and a glass ceramic are satisfactory for such standards. The probable accuracy of measurement of the real part of the dielectric constant is estimated at + or − 0.3 percent. Loss measurements are discussed. A correction is developed for the error resulting from the small airgap often present around the sample in transmission-line measurements. The effects of humidity and temperature variations are examined, and preliminary results of measurements to 800 C are given. Author

N70-39595# National Bureau of Standards, Boulder, Colo.
ABSOLUTE DETERMINATION OF REFRACTIVE INDICES OF GASES AT 47.7 GIGAHERTZ
A. C. Newell and R. C. Baird *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 374–383 refs (See N70-39551 22-09)
Avail: SOD $5.50

The refractive index of a gas is determined to high accuracy by measuring the change in the resonant frequency when the gas is admitted to a previously evacuated microwave cavity. The resonant frequency of the cavity is detected by means of a hybrid tee bridge circuit. When the cavity is matched to the waveguide the null at resonance is very sharp, and the frequency can be set to + or − 5 parts in 100 million. A conventional cylindrical cavity and a Fabry-Perot resonator one plane and one spherical mirror were used. Measurements were made with both structures on each gas, and the agreement between the two was within the limits of experimental error. Because the Fabry-Perot resonator has no side walls, air could be passed through it much more easily, and it is therefore preferred for use with moist air. Author

N70-39596# National Bureau of Standards, Boulder, Colo.
A RADIO-FREQUENCY PERMITTIMETER
R. C. Powell and A. L. Rasmussen *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 383–388 refs Sponsored in part by Navy Dept. Presented at Conf. on Std. and Electron. Meas., 1960 (See N70-39551 22-09)
Avail: SOD $5.50

The RF permittimeter utilizes a circular electric field in a ring-shaped sample to eliminate electrode and series inductance problems. The instrument is a two-terminal coaxial system designed for making measurements on conventional HF impedance measuring equipment. The instrument is analysed as a T-network and calibrated using the cases of no secondary, a low-resistance copper ring secondary, and a known resistance secondary with skin effect eliminated. The specimen to be measured consists of a solid ring of material or a liquid in a ring-shaped container. Precision of greater than 1% is difficult to obtain. Measurements show (1) values of permittivity of many ferrites to be much higher than those obtained by electrode methods and (2) the conductivity of strong electrolytic solutions has a strong out-of-phase component. Author

N70-39602# National Bureau of Standards, Boulder, Colo.
PRECISION DETECTOR FOR COMPLEX INSERTION RATIO MEASURING SYSTEMS
C. M. Allred and R. A. Lawton *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 425–430 refs (See N70-39551 22-09)
Avail: SOD $5.50

A precision, low noise, highly sensitive, synchronous RF detector is described that permits simultaneous phase and level nulling in complex insertion ratio measuring systems. This insertion ratio is a measure of both the phase shift and magnitude change produced by a network when inserted in a transmission path. Author

N70-39645*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRONICS SYSTEMS SRT
In its Res. and Advanced Develop., Vol. 2 15 Feb. 1970 p 317–462 refs (See N70-39642 22-34)
Copyright. Avail: NTIS HC $10.00/MF $0.65

Advanced concepts are discussed for guidance and control systems, communications, tracking and data acquisition, data handling and processing, instrumentation, and electronics techniques and components for space application. R.B.

N70-39728# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INTERMODULATION PRODUCT AND SWITCHING NOISE AMPLITUDES OF A P-I-N DIODE SWITCH IN THE WHF BAND
Raymond L. Sicotte and Robert N. Assaly Repr. from IEEE Trans. on Microwave Theory and Tech., v. MTT-18, no. 1, Jan. 1970 p 48–50 ref revised
(Contract AF 19(628)-5167)
(AD-707830; JA-3396; ESD-TR-70-80-Rev) Avail: NTIS CSCL 9/1

The correspondence describes some measurements of intermodulation product and switching noise amplitudes at UHF in a p-i-n diode switch. Author (TAB)

N70-39770*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYNCHRONOUS ORBIT BATTERY CYCLER
David A. Baer Jul. 1970 22 p
(NASA-TM-X-65339; X-716-70-260) Avail: NTIS CSCL 09E

A device was developed to simulate the charge/discharge cycling a battery will experience in a synchronous orbit satellite. This device will be used in battery testing to establish design parameters and battery performance for synchronous orbit use. Author

N70-39791*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENGINEERING MECHANICS DIVISION
In its Space Programs Sum. No. 37-63, Vol. 3 30 Jun. 1970 p 124–149 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 09E

Described is the design and construction of a prototype conical high gain antenna that permits easy bending of the reflector surface during furling without introducing sharp bending. Various adhesive polymer materials are evaluated and selected for application in future long-term planetary mission spacecraft. Minimum weight design considerations for shells of revolution by the Simplex method gave good results. A brief summary is given of the hybrid

prototype method for functionally checking electronic layouts prior to processing by conductor patterns, and electronic packaging and cabling methods for electrical spacecraft equipment are also outlined. G.G.

N70-39872# Naval Research Lab., Washington, D.C. Electron Physics Branch.
SWITCHING INVERTER WITH SINE-WAVE OUTPUT Final Report
J. M. Marzolf 3 Jun. 1970 11 p
(AD-708378; NRL-7099) Avail: NTIS CSCL 10/2

A relatively simple method of obtaining a multiple-stepped sine-wave output using semiconductor devices as switches was developed. This circuit employs Triacs as power switches, requiring approximately one-fourth the number of switches normally required by conventional techniques. The shift register used to drive the switches was composed of discrete components, but commercially available integrated circuits could probably be substituted. Since the basic inverter operates at a higher frequency, its size and weight are very greatly reduced compared to that of a conventional inverter for the same rating. Because the output closely approximates a sine wave, the filtering required is considerably less than that for a conventional inverter. Author (TAB)

N70-39887# Rutgers Univ., New Brunswick, N.J. Ceramic Research Station.
INSULATION STUDIES FOR HIGH POWER TUBES Final Report, 27 Jan. – 26 Sep. 1969
H. C. McGowan, E. J. Smoke, and D. L. Frey Mar. 1970 86 p refs
(Contract DAAB07-69-C-0178)
(AD-707946; ECOM-0178-F) Avail: NTIS CSCL 9/1

A feasibility study of insulation materials for application in high power electron tubes was made. Pertinent properties included: low dielectric constant (< 3.0), low dielectric loss (L0.0001), high thermal conductivity (0.5 cal/cm, sec, C). After an extensive literature search, a theoretical study was carried out on the fundamental factors affecting a materials property values. This was extended to include those materials, currently available, which most closely approximate the target values. The approaches to determine the feasibility of developing the desired new material centered around three areas: (1) observation of property value ranges for material classes, (2) analysis of property value trends for families of compounds based on the position of their elements in the Periodic Table, (3) a similar analysis based on the more promising crystal structures as predicted by radius ratios. No new material was found which better approximated the ideal than do BeO and BN. The trends in the data do not give much hope of finding a more ideal new compound. This study concludes that the most feasible approach to a closer approximation of the target values would be the growth and utilization of BN in whisker form. Author (TAB)

N70-39915* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HIGH SPEED LOW LEVEL ELECTRICAL STEPPING SWITCH Patent
John Dimeff, inventor (to NASA) Issued 29 Jan. 1963 (Filed 2 Aug. 1960) 6 p Cl. 200-19
(NASA-Case-XAC-00060; US-Patent-3,076,065; US-Patent-Appl-SN-47121) Avail: US Patent Office

A high speed commutating switch for low level voltage inputs, of the order of zero to one hundred microvolts, is described. The switch sequentially connects a plurality of low level voltage inputs to a recording device. It operates without the introduction of appreciable noise while being switched from one channel to another at high speed. The circuit arrangement involves mounted symmetrically arranged contact pairs of conductors, each pair representing an input channel. Electrical error signals generated in one contact oppose and cancel error signals in the other. The means for connecting the contact pairs with the conductive element is an air current. The design of the construction minimizes the kinetic and thermal energy dissipated in the contacts on closure. P.A.B.

N70-39933# Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.
A THREE-POLE ANALOG CANCELLATION FILTER WITH VARIABLE PASSBAND FOR USE IN RANGE-GATED RADARS
Harold Lee Broberg (M.S. Thesis) Dec. 1969 79 p refs
(AD-708048) Avail: NTIS CSCL 9/5

The design considerations and synthesis procedures involved in construction of a variable-passband analog cancellation filter for use in a range-gated Moving-Target-Indication (MTI) radar are presented. A three-pole Chebychev comb filter built using field-effect transistors and integrated-circuit operational amplifiers was tested and the results are compared with theoretical values. The merits of this type of filter in a range-gated radar are discussed and the performance of a complete range channel containing the filter is compared in the AN/UPS-1 air-search radar with normal radar operation using a delay-line canceller. Author (TAB)

N70-39936# Naval Postgraduate School, Monterey, Calif.
A STUDY OF TRANSIENT RADIATION EFFECTS ON THE RESPONSE OF STANDARD AND RADIATION HARDENED INTEGRATED CIRCUIT OPERATIONAL AMPLIFIERS IN AN ELECTRON BEAM
Patric Stam Enright (M.S. Thesis) Dec. 1969 51 p refs
(AD-708393) Avail: NTIS CSCL 9/5

This study investigates the effects of 1-Musec pulses of 80 - 90 Mev electrons on the standard MuA709 operational amplifier and its radiation-hardened version, the MUA744. The transient responses from the electron beam and from electronic pulses were investigated and compared for each amplifier. Also investigated were the responses of dielectrically isolated NPN and PNP transistors contained in the MuA744, which were further compared with responses obtained from discrete NPN and PNP transistors. The overall transient radiation responses of the MuA709 and MuA744 amplifiers, with several exceptions, were not very different. The same can be said for a comparison of the responses from the MuA744 and discrete NPN and PNP transistors. Based on this study the MuA744 is not superior to the MuA709 by virtue of its radiation hardening. It should be noted, however, that the MuA709 is driven into oscillation by the electron beam while the MuA744 is not. Author (TAB)

N70-39993# Stanford Univ., Calif. Dept. of Electrical Engineering.
ON TIME-VARIABLE GYRATORS WITH POSITIVE AND NEGATIVE GYRATION CONDUCTANCES
J. Woodard (Sylvania Electr. Systems-West) and R. W. Newcomb Jun. 1970 6 p refs
(Contract F44620-67-C0001)
(AD-707623; AFOSR-70-1683TR) Avail: NTIS CSCL 9/5

By the use of two parallel but reversed polarity gyrators, only one of which is generally operative, the practical problem of sign switching of gyration conductances for time-variable gyrators is solved. Author (TAB)

N70-40018*# Lockheed Electronics Co., Houston, Tex.
COMPLEMENTARY MOS MONOSTABLE MULTIVIBRATOR Patent Application

Robert W. O'Neill, inventor (to NASA) Filed 8 Jul. 1970 13 p Sponsored by NASA
(NASA-Case-MSC-13492-1; US-Patent-Appl-SN-53156) Avail: NTIS CSCL 09E

First and second positive NOR complementary MOS gates are employed to form a monostable multivibrator circuit in which the output of the first gate forms the input to the second gate and the output of the second gate forms the system output. The trigger signal supplied to the gates is differentiated through a resistance-capacitance circuit and supplied to the first gate. The differentiated signal may be bypassed across the first gate through a semi-conductor diode to the input of the second gate to permit narrow pulse width outputs to reduce input pulse power and to increase the duty cycle of the circuit. A feedback capacitor connected across both gates is employed in an internal resistance-capacitance circuit to provide the time constant for the multivibrator. In a modified form, a plurality of monostable multi-vibrator circuits are employed together to generate a sequence of control pulses in a data processor. NASA

N70-40020*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
INTEGRATED THERMOELECTRIC GENERATOR/ANTENNA Patent Application
Gerald L. Pucillo, inventor (to NASA) Filed 29 Oct. 1970 10 p
(NASA-Case-XER-9521; US-Patent-Appl-SN-771530) Avail: NTIS CSCL 09E

An antenna is formed of a sandwich of hot and cold thermoelectric elements, such as bismuth and tellurium. Power storage means are connected to the antenna to receive and store the power generated by the thermoelectric action between the elements. In addition, transmitting and receiving means are connected to the antenna so that the antenna transmits and receives signals. Further, a separate source of heat is connected to the hot thermoelectric element to provide an auxiliary source of heat for that element when the antenna is not receiving energy from a hot body. NASA

N70-40054# Illinois Univ., Urbana. Coordinated Science Lab.
FAULT TESTING IN COMBINATIONAL CELLULAR ARRAYS
Sharad Chandra Seth (Ph.D. Thesis) May 1970 72 p refs
(Contract DAAB07-67-C-0199; Grant NSF GK-15459)
(AD-707689; R-470; UILU-eng-70-215) Avail: NTIS CSCL 9/5

The problem of detecting faults in fixed cell function arrays is studied. The study is naturally divided into two independent aspects: the problems of applying tests to each individual cell in an array and of progating the effect of an internal fault to observable outputs. These have been called the problems of test application and fault propagation respectively. The testability of an array depends on a successful solution to each of these problems. By the considerations of symmetry, duality, and permutation of interconnecting lines, it is shown how the cell functions can be partitioned into test-equivalent classes. It is then sufficient to determine the testability of only one representative from each class. Separate necessary and sufficient conditions are obtained for the test application problem. The fault propagation problem is studied for linear cascades but the results are shown to extendable to other modes of fault propagation. An evalustion of cell functions, based upon the testability of arrays formed from them, is possible by applying the results discussed in the report. TAB

N70-40060*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESETTABLE MONOSTABLE PULSE GENERATOR Patent Application
Norman M. Garrahan, inventor (to NASA) Filed 30 Aug. 1968 19 p
(NASA-Case-GSFC-11139; US-Patent-Appl-SN-756511) Avail: NTIS CSCL 09E

A resettable monostable pulse generator including a charge run-down timing circuit is described. The charge run-down timing circuit includes a capacitor that is charged to a peak value by a random pulse from a constant amplitude pulse source. After being charged, the capacitor immediately starts to discharge toward zero. In addition, an output pulse generator starts to generate an output pulse as soon as the capacitor is charged to its peak value and continues to generate the output pulse until the charge drops to a predetermined level. If a second pulse from the constant amplitude pulse source occurs during this run-down period, the capacitor is again charged to its peak value. This reset pulse prevents termination of the output pulse and recycles the termination time of the output pulse (pulse width) to be measured from the inception of the last reset pulse. Each time a reset pulse occurs during a run-down period, the capacitor is recharged to its peak value, hence, the output pulse can exist for a short or long period of time depending on the occurrence of random reset pulses. NASA

N70-40112# Stanford Univ., Calif. Dept. of Computer Science.
ON THE SYNTHESIS OF FINITE-STATE ACCEPTORS
Alan W. Biermann and Jerome A. Feldman Apr. 1970 34 p refs
(Contract ARPA SD-183)
(AD-708080; SU-AIM-114) Avail: NTIS CSCL 9/2

Two algorithms are presented for solving the following problem: Given a finite-set S of strings of symbols, find a finite-state machine which will accept the strings of S and possibly some additional strings which resemble those of S. The approach used is to directly construct the states and transitions of the acceptor machine from the string information. The algorithms include a parameter which enable one to increase the exactness of the resulting machines behavior as much as desired by increasing the number of states in the machine. The properties of the algorithms are presented and illustrated with a number of examples. The paper gives a method for identifying a finite-state language from a randomly chosen finite subset of the language if the subset is large enough and if a bound is known on the number of states required to recognize the language. Finally, some of the uses of the algorithms and their relationship to the problem of grammatical inference are discussed. Author (TAB)

N70-40123* Cornell Univ., Ithaca, N.Y.
FLUX SENSING DEVICE USING A TUBULAR CORE WITH TOROIDAL GATING COIL AND SOLENOIDAL OUTPUT COIL WOUND THEREON Patent
Sung Ching Ling, inventor (to NASA) Issued 16 Nov. 1965 (Filed 29 Nov. 1961) 8 p Cl. 324-43 Sponsored by NASA
(NASA-Case-XGS-01881; US-Patent-3,218,547; US-Patent-Appl-SN-155584) Avail: US Patent Office CSCL 09E

A flux gate magnetometer is described in which gating flux leakage is minimized and decoupled from the ambient flux to be measured by the device. The device employs a tubular high-permeability core of permalloy or ferrite having a gating flux toroidal winding wound on the core and a surrounding solenoidal pickup coil wound about the core. The tubular magnetic core is uniformly saturated by a gating field provided by application of alternating current to the toroidal gating flux winding, thus reducing the residual flux in the core to a minimum. By arranging the gating field perpendicular to the solenoidal pickup, Barkhausen noise generated by the gating field is also decoupled form the pickup coil, allowing detection of extremely weak ambient fields to 0.1 gamma. The device is useful as a low-level signal modulator or modulating magnetic amplifier. R.B.

N70-40167# Clemson Univ., S.C. Dept. of Electrical and Computer Engineering.
GATE SELECTION FOR MULTIPLE VALUED LOGIC SYSTEMS Final Report
Robert W. Snelsire and James H. Rash [1970] 44 p refs
(Contract N00014-69-C-0232)
(AD-708766) Avail: NTIS CSCL 9/2

With the development of the integrated circuit and growth of microcircuitry, the use of multi-state devices and multi-valued logic functions in the place of presently used binary systems is becoming increasingly more feasible. A method for N-valued system design that optimizes the cost, however, has thus far not been developed. This thesis presents a choice of a four-gate set which will reduce the average cost of implementation for a truth table. The set is composed of the minimum (AND) gate, the maximum (OR) gate, the modulo-N add gate, and a NOT gate specially defined for multi-valued systems. The choice is a compromise to require the manufacture of only four different gates, and yet the various combinations of the four gates can offer enough flexibility to cover output requirements with a reduced implementation cost. Author (TAB)

N70-40179# Los Alamos Scientific Lab., N.Mex.
THE B MODIFICATION OF TACS1
Charles L. Wilson 20 Apr. 1970 38 p refs
(Contract W-7405-eng-36)
(LA-4205-Add) Avail: NTIS

The B modification of the TACS1 (Transport And Charge Storage) program was developed to include more generalized boundary conditions and allow the compilation of transistors and Shotkey barrier phenomena. To accomplish these objectives, minority carrier injection and the displacement of the equilibrium Fermi level by an arbitrary contact potential are allowed. Author

N70-40185# Naval Research Lab., Washington, D.C.
SOLID STATE MILLIMETER WAVE SOURCES FOR CAINS Interim Report
J. J. Ayoub, Jr. May 1970 18 p refs
(AD-707708; NRL-MR-2132) Avail: NTIS CSCL 9/1

The state of the art of Millimeter Wave Varactor Multipliers, IMPATT and Gunn Effect Oscillators is reviewed. The relative merits of using these sources as the local oscillator in an aircraft mounted millimeter wave receiver are discussed. This includes a discussion of the basic limitations, the practical limitations, and the need for determining the device performance from the systems designers viewpoint. Author (TAB)

N70-40189# Westinghouse Research Labs., Pittsburgh, Pa.
SURFACE WAVE PHENOMENA Interim Report, 1 Aug. 1969 – 30 Apr. 1970
John de Klerk May 1970 77 p refs
(Contract N00014-69-C-0118)
(AD-707758; Rept-70-9J2-ACOUS-R1) Avail: NTIS CSCL 9/1

An analytical method for characterization of piezoelectric materials for use as elastic surface wave devices is described. This method is used to design a prototype delay line. An apparatus for measurement of velocity and energy flow of surface waves on materials such as quartz and LiNbO3 is described. Measurements of acoustic radiation resistance and reactance, velocity, energy flow and harmonic generation are recorded. Author (TAB)

N70-40234* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVICE FOR DIRECTIONALLY CONTROLLING ELECTROMAGNETIC RADIATION Patent
Morris Perlmutter and John R. Howell, inventors (to NASA) Issued 18 Jan. 1966 (Filed 5 Mar. 1964) 5 p Cl. 126-270
(NASA-Case-XLE-01716; US-Patent-3,229,682; US-Patent-Appl-SN-349778) Avail: US Patent Office CSCL 09E

An apparatus is described which can be used for either directing the emission of electromagnetic radiation in preferred directions or absorbing electromagnetic radiation only from desired angular ranges. Solar energy is directed toward an energy converter by selectively arranging the absorbing and reflecting surfaces of the device. R.B.

N70-40272* Smith Electronics, Inc., Cleveland, Ohio.
PHASE DETECTOR ASSEMBLY Patent
Gordon D. Anderson, inventor (to NASA) Issued 16 Nov. 1965 (Filed 28 Feb. 1963) 11 p Cl. 307-88.5 Sponsored by NASA
(NASA-Case-XMF-00701; US-Patent-3,218,479; US-Patent-Appl-SN-261917) Avail: US Patent Office CSCL 09E

A device is described which detects a first signal in terms of the presence or absence of a second signal at the time of occurrence of the first signal. Two nonlinear circuits are provided, each of which contains a resistive element and a two-terminal nonlinear circuit with a first and second positive resistance region separated by a negative resistance region. Biasing elements are connected across the nonlinear circuits in a polarity to bias both nonlinear circuits in the first positive resistance region. A sensing element is connected across the uncommon nonlinear circuits to read out the output of the discriminator. R.B.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N70-39108 California Univ., Berkeley.
INPUT OUTPUT STABILITY IN NONLINEAR SYSTEMS USING LIAPUNOV METHODS
Richard Francis Estrada (Ph.D. Thesis) 1969 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 18913

A theory is given with sufficient conditions for Liapunov stability, L2-input L2-output stability, and bounded-input bounded-state stability, which are roughly connected with ascending degrees of passivity. The general theory is applied to feedback systems using Popov type conditions, multiplier techniques, and others. The first of the specific feedback systems considered has a linear time-invariant system, with an infinite dimensional state space, in the forward loop; and a memoryless nonlinear time-varying amplifier in the return loop. The second feedback system has the same forward loop as the first system but has a memoryless linear time-varying amplifier in the return loop. The third feedback system has a linear time-varying system with a finite dimensional state space in the forward loop and a memoryless nonlinear time-varying amplifier in the return loop. Dissert. Abstr.

N70-39258 Michigan Univ., Ann Arbor.
STABILITY OF THE BASIC NONLINEAR OPERATOR FEEDBACK SYSTEM
Mark Johannes Damborg (Ph.D. Thesis) 1969 217 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 69-17986

The stability properties of what is denoted the basic nonlinear feedback system are studied. Given a physical system modeled by the operator K defined on some appropriate function space, the question is asked: When is it possible to construct a negative

feedback path around K such that the resulting feedback system is input-output stable? All dynamics of the system are assumed lumped into the operator K to suppress any problems of interconnecting systems and to expose the essence of the feedback problem. The object of this research was to determine conditions or tests on the operator K which will ensure that the feedback system is stable in the above sense. Dissert. Abstr.

N70-39574# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
INSERTION LOSS CONCEPTS
Robert W. Beatty *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 199-207 refs Presented at URSI-IRE Spring Meeting, Washington, D.C. 2 May 1962 (See N70-39551 22-09)
Avail: SOD $5.50

Other concepts connected with insertion loss such as attentuation and mismatch loss are clarified. A logical set of definitions and equations are presented as a suggested approach to more precise terminology. The effect of complex characteristic impedance on the equations is given. Specific suggestions are given for changes in the usage of terms to improve terminology. Author

N70-39582# National Bureau of Standards, Boulder, Colo.
DEFINITIONS OF v, i, Z, Y, a, b, GAMMA, AND S
David M. Kerns *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 279-287 refs (See N70-39551 22-09)
Avail: SOD $5.50

Concepts and conditions underlying the establishment and use of emmittance and scattering matrix descriptions of waveguide n-ports are discussed. The TEM modes are considered and no restriction to high or microwave frequencies is implied. The discussion is critical and intensive rather than general. Needed results of electromagnetic (and waveguide) theory are assumed. Emphasis is placed on defining basic quantities needed in the matrix scheme. These include generalized voltage and current for waveguide modes, modual impedance, modal characteristic impedance, the emmittance matrices, traveling wave amplitudes, reflection coefficient, and the scattering matrix. Author

N70-39651# Houston Univ., Tex. Dept. of Electrical Engineering.
UHCAP USERS MANUAL
G. F. Paskusz, A. D. Alley, and R. F. Miller May 1970 69 p refs
(Contract N00014-68-A-0151)
(AD-708051; THEMIS-RE-1-70) Avail: NTIS CSCL 9/5

The UHCAP Program is designed for circuit and system analysis. The purpose of the manual is to help potential users by defining programming capabilities and cataloging programming rules. Author (TAB)

N70-39876# Stanford Univ., Calif. Dept. of Electrical Engineering.
A PASSIVE SYNTHESIS FOR TIME-INVARIANT TRANSFER FUNCTIONS
P. Dewilde, L. Silverman (Univ. of Southern Calif., Los Angeles), and R. Newcomb 2 Jul. 1969 22 p refs
(Contract F44620-67-C-0001; Grant NSF GK-1956)
(AD-707624; AFOSR-70-1684TR) Avail: NTIS CSCL 9/5

A passive transfer function synthesis based upon state-space techniques is presented. The method rests upon the formation of a coupling admittance which when synthesized by resistors and gyrators is to be loaded by capacitors whose voltages form the state. By the use of a Lyapunov transformation the coupling admittance is made positive-real, while further transformations allow internal dissipation to be moved to the source or the load. A general class of configurations applicable to integrated circuits is obtained which uses only grounded gyrators, resistors, and a minimal number of capacitors. The minimum number of resistors for the structure is also obtained. The technique illustrates how state-variable theory can be used to obtain results not yet available through other methods. Author (TAB)

N70-39916# Stanford Univ., Calif. Dept. of Electrical Engineering.
INTEGRATED DVCCS GENERATION OF ALL FINITE CIRCUITS
M. Bialko and R. W. Newcomb Jun. 1970 9 p refs
(Contract F44620-67-C-0001; Grant NSF GK-16240)
(AD-707625; AFOSR-70-1685TR) Avail: NTIS CSCL 9/5

In conjunction with the capacitor, the differential voltage controlled current source (DVCCS) is shown to relatively simply yield all components needed for linear circuit construction in integrated form. The effects of dissipative losses in the DVCCS are tabulated for several configurations. Author (TAB)

N70-40153*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A VERSATILE, LOW COST PACKAGING TECHNIQUE FOR SPACECRAFT ELECTRONICS
Harry Chernikoff Sep. 1970 31 p
(NASA-TM-X-65331; X-715-70-333) Avail: NTIS CSCL 09C

A spacecraft computer known as the on-board processor (OBP) was developed. Two packages, the input/output unit (I/O) and the central processing unit (CPU) were fabricated using a point-to-point wiring technique known as Micropoint. This technique utilizes teflon insulated nickel wire and gold plated stainless steel pins pressed into glass epoxy boards to produce high density, low cost circuit boards. Most of the circuits in the I/O and CPU are flatpacks; this allowed the design of a standard board. The boards consist of 1/16 inch glass-epoxy double sided printed circuit (PC) material having the power plane on one side and the ground plane on the other. Ground and power pins are soldered to the PC. Flat ribbon cable interconnects the circuit boards through a single centrally located grandmother board. The flatpacks are gap-welded and discrete components are soldered to the pins. The boards are then conformal coated with polyurethane and the units are potted with clear silicone rubber. These units have successfully completed qualification level environmental tests. Author

N70-40177# Stanford Univ., Calif. Dept. of Electrical Engineering.
INTEGRATED MICROMOTOR CONCEPTS
K. Dutta, P. Dev, R. Dewilde, B. Sharma (Maryland Univ.), and R. W. Newcomb (Maryland Univ.) Jun. 1970 4 p
(Contract F44620-67-C-0001; Grant AF-AFOSR-1910-70)
(AD-707622; AFOSR-70-1682TR) Avail: NTIS CSCL 9/3

The concept of an integrated micromotor is introduced and the philosophy of operation and fabrication are discussed. The motor considered has a working surface which covers a circular area of 200 microns radius. The final device has an eddy current driven free rotor floating on spiral groove bearings and is processed on a silicon chip using monolithic and compatible thin film fabrication techniques. Author (TAB)

N70-40216# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
AN EDDY CURRENT TUBE TESTING TECHNIQUE USING A HYBRID COIL CONFIGURATION WITH SEQUENTIAL SAMPLING
J. Ryden, Jr. May 1970 15 p refs
(Contract AT(45-1)-1830)
(BNWL-1355) Avail: NTIS

A new eddy current tube testing technique has been developed. This technique has increased resolution and sensitivity to defects and a reduction of nonpertinent tubing variations as compared to

the encircling coil technique. This is accomplished with no loss of inspection rate. The new technique utilizes a hybrid coil configuration consisting of both encircling coils and probe coils. The encircling coils are used as the drivers. A plurality of probe coils, mounted between the encircling coils around the coil form circumference, serve as the pickups. These are sequentially sampled at a rapid rate; thus, a 100% inspection of the tube is performed by only translating the tube through the coil form. Author (NSA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N70-39116# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

DUTY CYCLE OF ACCELERATORS. INFLUENCE OF NUCLEAR PHYSICS EXPERIMENTS. PILE-UP, RANDOM COINCIDENCES [LE CYCLE UTILE DES ACCELERATUERS. INCIDENCES SUR LES EXPERIENCES DE PHYSIQUE NUCLEAIRE EMPILEMENTS, COINCIDENCES FORTUITES]

Jacques Pottier Apr. 1970 22 p refs In FRENCH
(CEA-N-1235) Avail: AEC Depository Libraries

The effects of the duty-cycle of accelerators on the experimental measurements are evaluated (pile-up, random coincidences). It is shown that, in almost all cases, a large duty cycle is to be preferred. Nevertheless, a short pulse duration is necessary when coincidence measurements are performed with a device of long resolution time and is useful when a counting is made after the beam pulse. NSA

N70-39235# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Kernphysik.

COMPARISON OF THE COST OF A MISSING MAGNET AND A MISSING POWER-VERSION FOR THE 250/500 GeV SYNCHROTRON LATTICE MR 29

Friedrich Arendt Oct. 1969 7 p
(NP-18224) Avail: AEC Depository Libraries

The first stage in building a synchrotron could be the construction of a machine with 1/2 the actual design energy. This may be achieved by leaving out one half of the magnets initially (missing magnet) or by installing only 1/4 of the power supply (missing power). For the case of the MR 29-lattice of the big European synchrotron, the relative advantages of both versions are discussed. It turns out that the overall cost (construction plus running costs) is comparable for both types. Author

N70-39236# Kernforschungszentrum, Karlsruhe (West Germany) Inst. fuer Experimentelle Kernphysik.

VARIABLE SUPERCRITICAL COUPLING FOR SUPERCONDUCTING ACCELERATOR STRUCTURE

Klaus Pack Dec. 1969 71 p refs In GERMAN
(NP-18229) Avail: AEC Depository Libraries

The feasibility of different methods of measuring the coupling coefficients was investigated theoretically. It turns out that the power transmitted is most practical to determine high and low coupling coefficients. Experimental investigations concerned coupling systems with loops and holes. The result was that the loop system was not sufficient because the desired coupling coefficient had not been achieved. By contrast, hold coupling turns out to be the better solution. With this hole coupling system, the coupling coefficient can be varied by a factor of about 50. Author (NSA)

N70-39271# Royal Aircraft Establishment, Famborough (England).

MEMORANDUM ON TEST FACILITIES REQUIRED IN PARACHUTE TECHNOLOGY [DENKSCHRIFT UEBER NOTWENDIGE VERSUCHSEINRICHTUNGEN AUF DEM GEBIET DER FALLSCHIRMTECHNIK

H.-D. Melzig Mar. 1970 51 p Transl. into ENGLISH from Deut. Forschungsanstalt Luftfahrt e.V., no. 0460, Jan. 1968
(RAE-LIB-Trans-1447) Avail: NTIS

The present state of parachute technology in Western Europe and the United States is evaluated. Various outstanding problems and possible methods of solution are discussed. A vertical tower is described, the interior of which can be depressurized and in which model tests of aerodynamic deceleration systems can be made. The proposed instrumentation for the tower is described in detail. Author

N70-39277*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MOONLAB: A DESIGN FOR A SEMIPERMANENT LUNAR BASE

John Billingham and James Adams (Stanford Univ.) *In its* Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 1–9 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 22A

The design is described of a base at Grimaldi for scientific exploration, with particular emphasis on astronomy. The base would evolve over a 15-year period, requiring 37 launches of Saturn 5 delivery systems. The completed base would consist of 11 interconnected modules. Eight of these are for the shelter of the crew (24 men at base completion) and equipment. The other three, which are inflated structures partially transparent to sunlight, contain a lunar farm of higher plants. This farm, a significant feature of the design, provides humidity control, oxygen generation, CO_2 removal, and a major part of the caloric requirements in food. Power is supplied to the base by solar cell arrays during the day and fuel cells at night. Provisions are made for lunar exploration, use of lunar rocks and soil for many purposes, and emergency backup procedures. Author

N70-39279*# Boeing Co., Huntsville, Ala.

NO-LOSS CRYOGENIC STORAGE ON THE LUNAR SURFACE

J. H. Bell, Jr. *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 23–30 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 22A

A technique for storing oxygen and hydrogen cryogens for a period of 6 months to a year is described. This theory is based on the best cryogenic information available at this time. A study was made to determine the best method of storing propellants on the lunar surface; the results of this study are also presented. Curves were plotted for optimizing the design, and equipment layouts are presented showing designs and materials selected for best results. Author

N70-39347# Heidelberg Univ. (West Germany). Physikalisches Inst.

CYLINDRICAL SPARK CHAMBER SYSTEM WITH MAGNETOSTRICTIVE READOUT [EIN ZYLINDRISCHES FUNKENKAMMERSYSTEM MIT MAGNETOSTRIKTIVER AUSLESE]

M. Beckermann, J. Heintze, H. W. Siebert, and H. Stelzer Dec. 1969 5 p refs In GERMAN
(BMBW-FBK-69-45) Avail: AEC Depository Libraries

A system of concentric cylindrical spark chambers with magnetostrictive readout is described. Each chamber consists of two self-supporting electrode cylinders made out of printed circuit

foil with wire strips spiralling along the cylinders in opposite directions. This allows accurate two-dimensional readout of rectangular coordinates through readout wires strung around one edge of the cylinders. Therefore the chambers contain no dead zones or support materials in the sensitive part of the cylinder. The precision of spark location, as gained from an experiment at CERN, was 1.6 mm FWHM in the longitudinal and 1.3 mm FWHM in the azimuthal direction. Author (NSA)

N70-39385# Sandia Corp., Albuquerque, N.Mex.
MINICOMPUTER-CONTROLLED TESTING SYSTEMS
W. W. Shurtleff and F. M. Roddy Aug. 1969 25 p refs
(SC-DR-70-60) Avail: NTIS

This report discusses minicomputer-controlled testing systems for components such as integrated circuits, semiconductor circuits, and hybrid circuits. It is based upon a study and proposal for an automated hybrid test system. General topics discussed are: the reasons for automation, the signal generating and measuring equipment presently available that is compatible with minicomputers, the user-tester interface, and building an automated test system. NSA

N70-39467*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
GENERAL CRITERIA FOR DESIGN OF NEW EQUIPMENT AND FACILITIES TO BE UTILIZED AT KSC
15 Jul. 1970 49 p refs
(NASA-TM-X-66314; Avail: NTIS CSCL 14B

A brief summation of general requirement for use by designers of new equipment and facilities to be used at the John F. Kennedy Space Center (KSC) is presented. The general requirements were developed from past experience in the space program, and are meant to improve equipment and facilities in a manner that will enable the operators and maintenance personnel to perform more efficiently. Simplicity of operation and maintenance, cost effectiveness, and good design are emphasized. The requirements listed supplement rather than replace existing specifications. Author

N70-39470# European Organization for Nuclear Research, Geneva (Switzerland).
RECOMMENDATIONS FOR ELECTROMAGNETIC SHIELDING OF PREMISES
V. V. Chekhovich et al Sep. 1969 147 p refs Transl. into FRENCH from the Russian
(CERN-Trans-69-21) Avail: AEC Depository Libraries

Shielded premises and rooms have a large utilization in industry, scientific institutes, medical centers, etc. In the majority of these cases, the premises and rooms are developed by the institute itself, as at the present there is no unified project of recommendations and constructions of element types. The present recommendation has the purpose of contributing a technical and in the choice, selection, and mounting of shielded premises and rooms, designed to give a shielding efficiency of the order of 80 to 100 db and 40 to 60 db in the frequency range from 0.15 to 1000 MHz and a shielding efficiency of 80 to 100 db in the range from 0.15 to 150 MHz. Questions on the application of shielded premises and rooms, their construction, the filtering of the electric net, and the report of methods of verification of the shielding efficiency of the premises and of the filter parameters are given. A group of contractors have participated in the development of the elements of shielded premises and rooms. Author (NSA)

N70-39513# European Organization for Nuclear Research, Geneva (Switzerland). Radiotechnical Inst.
THE ACCELERATING SYSTEM OF THE 1000-GeV CYBERNETIC PROTON ACCELERATOR
Yu. N. Antonov et al Dec. 1969 8 p Transl. into ENGLISH from Akad. Nauk SSSR, Radioteknn. Inst. (Moscow), Rept. No. NTD-688, 1968
(CERN-Trans-69-33) Avail: AEC Depository Libraries.

Basic parameters of the accelerating system of 1000-GeV cybernetic proton accelerator are presented. A schematic of one of ferrite-tuned cavities is given and a block diagram of the accelerating system is included. NSA

N70-39545# Human Resources Research Organization, Alexandria, Va.
DESIGN AND PROCUREMENT BASES FOR COAST GUARD AIRCRAFT SIMULATORS
Paul W. Caro, Eugene R. Hall, and Gilbert E. Brown, Jr. Dec. 1969 60 p
(Contract DOT-CG-92556A)
(AD-708209; HUMRRO-TR-69-103) Avail: CFSTI CSCL 5/9

The objective of the study undertaken by HumRRO was to analyze Coast Guard aviator training requirments in order to determine functional requirements for flight training devices or simulators necessary to support the Coast Guard flight training program. The study involved four steps: (1) analysis of operational missions and derivation of training requirements; (2) analysis of trainee input factors; (3) definition of the characteristics of required synthetic training equipment; and (4) development of plans for the funding and procurement of the required synthetic training equipment. Steps 1 and 2 have been reported, while Steps 3 and 4 are covered in this report. Author (TAB)

N70-39665# Kernforschungszentrum, Karsruhe (West Germany). Literaturabteilung.
CALCULATION OF MAGNETIC FIELDS IN MAGNETS WITH GAPS [BERECHNUNG DES MAGNETFELDES IN MAGNETEN MIT SPALTEN]
V. A. Papadichev 1969 21 p refs Transl. into GERMAN from Acad. Sci. USSR Preprint No. 69 In GERMAN
(KFK-tr-314) Avail: AEC Depository Libraries

A method for the calculation of the magnetic field in magnets with gaps was derived at various pole excitations. The results can be used for the calculation of the fields of isochronous cyclotrons, ring phasotraons and for consideration of the boundary effects. The coefficients of the Fourier series development were calculated for the periodic structures. The results were compared with experiment. Author (NSA)

N70-39673# Los Alamos Scientific Lab., N.Mex.
NUMERICAL SIMULATION OF A COLD TRAP FOR SODIUM PURIFICATION
B. C. Goplen, J. C. Biery, and C. C. McPheeters Apr. 1970 21 p refs
(Contract W-7405-eng-36)
(LA-4435) Avail: NTIS

The dynamic behavior of a sodium system cold trap was numerically simulated on a digital computer. The simulation accounted for mixing in the hold tank, delay times in pipes, temperature variation with distance in the cold traps, impurity buildup on the walls of the cold trap, and simultaneous precipitation and dissolution of the impurity in different portions the of the cold traps. The main purpose of the simulation was to generated mass transfer coefficients from experimental data taken from an experimental sodium loop. The program can also help in the design of sodium systems containing cold traps. Author (NSA)

N70-39695# Kernforschungszentrum, Karlsruhe (West Germany) Inst. fuer Experimentelle Kernphysik.
REVIEW ON THE SURVEYING OF CIRCULAR ACCELERATORS AND A PROPOSAL FOR A SYSTEM FOR

THE KARLSRUHE PROTON SYNCHROTRON PROJECT [UEBERSICHT UEBER-DIE VERMESSUNG VON KRIESBESCHLEUNIGERN UND EIN VORSCHLAG FUER EIN SYSTEM BEIM KARLSRUHER PROTONEN-SYNCHROTRON PROJEKT]

Gerd Krafft Dec. 1969 47 p refs *In* GERMAN
(NP-18226) Avail: AEC Depository Libraries

The precision placement of the magnets for the Karlsruhe proton synchrotron is considered. The selection of the measurement system was determined essentially by a machine with a CR (combined function) structure. Some general viewpoints on the selection of a measurement system for the placement of magnets are outlined. A brief review is given of measurement systems used in existing or planned accelerators. A comparison of the various methods for the vertical and horizontal placement of the magnets is made with respect to the Karlsruhe project. The differing effects of placement errors on the closed orbit in a CF structure and an SF machine are treated. The method proposed for the Karlsruhe proton synthrotron is then described. NSA

N70-39775# European Organization for Nuclear Research, Geneva (Switzerland).

THE CERN-TRIESTE MAGNETOSTRICTIVE WIRE SPARK CHAMBERS SYSTEM FOR THE LOW ENERGY PION DEUTERON AND PION PROTON SCATTERING EXPERIMENT AT THE CERN PROTOSYNCHROTRON

F. Bradamante, S. Conetti, G. Fidecaro, M. Fidecaro, M. Giorgi et al 1 Jun. 1969 94 p refs Prepared in cooperation with Ist. Nazl. di Fis. Nucl., Trieste, Italy
(INFN/AE-69/7) Avail: AEC Depository Libraries

The system of wire spark chambers with magnetostrictive readout which has been used in a low energy elastic scattering experiment at the CERN proton synchrotron is described. Details of the construction of the chambers, of the electronic readout, of the data acquisition system, and of the reconstruction program are given. Finally the precision attained in the experiment is discussed as a function of the various parameters of the system. Author (NSA)

N70-39793*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ENVIRONMENTAL SCIENCES DIVISION

In its Space Programs Sum. No. 37-63, Vol. 3 30 Jun. 1970 p 161–166 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 14B

The solar simulator uses a cluster of 37 lamps at 20-kW input each (740 kW total). The light from all lamps is combined by means of an integrating lens system and a 23-ft single-piece collimator. This arrangement provides a 15-ft-diam beam of the same intensity as true sunlight at earth orbit outside the atmosphere. The half angle subtended by the artificial sun is < 1 deg, and the spectrum is essentially the xenon arc spectrum. The system is designed to accept additional power by increasing the number of lamps in the cluster from 37 to 61 (20-kW each) for a total input of 1.22 MW. This extra power can be used to increase the beam diameter from 15 ft to 20 ft, but without improving the collimation angle, increasing the intensity, or improving the spectral characteristics. Magnetic control made it possible to improve the latter three characteristics and to increase thus the intrinsic brightness coming from the emitting area of each arc. Author

N70-40005# Army Foreign Science and Technology Center, Washington, D.C.

CLIMATIC CHAMBER FOR TESTING MINE ELECTRICAL EQUIPMENT

Yu. P. Antonov et al 30 Apr. 1970 9 p Transl. into ENGLISH from Electrotekhnika (USSR), v. 40, no. 2, 1969 p 51–52
(AD-707682; FSTC-HT-23-959-70) Avail: NTIS CSCL 14/2

The design of a climatic chamber for testing electrical mine equipment is described. A plan for measuring insulation resistance is presented. Author (TAB)

N70-40012# TRI-Univ. Meson Facility, Vancouver (British Columbia).

TRIUMF Annual Report, 1969

N. Brearley, ed. Feb. 1970 51 p refs
(NP-18206) Avail: AEC Depository Libraries

Topics include organization, plans for the TRIUMF facility, construction, status of the cyclotron and ancillary equipment, safety, the central region cyclotron model, project management and engineering, conferences reports, staff, financial statement, users groups and committees, and TRIUMF specifications. NSA

N70-40056# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

A PNEUMATIC CALIBRATION RIG FOR USE WITH A MAGNETIC SUSPENSION AND BALANCE SYSTEM Technical Report, Nov. 1967 – Aug. 1969

Milan Vlajinac Wright-Patterson AFB, Ohio ARL Jan. 1970 41 p refs
(Contract AF 33(615)-1470)
(AD-707858; TR-159; ARL-70-0016) Avail: NTIS CSCL 14/2

The preliminary investigation and design of a prototype pneumatic calibration rig for use with a magnetic suspension system is described. Results and performance of the pneumatic calibration rig are shown. Previous calibration techniques and advantages of this new technique are discussed. Author (TAB)

N70-40173# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

AN OPTIMIZATION OF STUDY OF THE UTIAS IMPLOSION-DRIVEN HYPERVELOCITY LAUNCHER MK 2

Robert F. Flagg and Gregory P. Mitchell Wright-Patterson AFB, Ohio ARL Apr. 1970 87 p refs
(Contract AF 33(615)-5313)
(AD-708798; UTIAS-TN-130; ARL-70-0075) Avail: NTIS CSCL 14/2

A detailed study is presented of the optimization of the projectile velocity of the proposed UTIAS MK II Implosion-Driven Hypervelocity Launcher. The projectile velocity was optimized with respect to four variables, namely explosive weight, initial loading pressure, hemispherical cavity size, and peak projectile acceleration or base pressure. The details of the dynamics of the waves which occur in the chamber and the dynamics of the projectile in the barrel were determined using a finite-difference computer program coded for use with the IBM 1130 computing machine. The code, which uses the von Neumann artificial viscosity technique to solve a set of nonlinear partial differential equations that describe the motion of the gas and projectile, did not contain such effects as radiative or convective heat losses, projectile-barrel friction, or ablation. The calculations therefore represent an ideal performance and set an upper bound on what can be expected in practice. Author (TAB)

N70-40257# All American Engineering Co., Wilmington, Del.

CAPSTAN DESIGN, LOW INERTIA TRANSMISSION STUDY Final Report

Linwood C. Robinson 25 May 1970 36 p
(Contract N00156-69-C-1897)
(AD-708759; AAE-N-585) Avail: NTIS CSCL 13/9

A capstan suitable for driving an energy absorber for aircraft recovery systems was designed. Performance analysis of various contours were obtained using a capstan analysis computer program. The design is for a 1-1/8 inch diameter steel cable and a cable tension ration of 12 to 1. Author (TAB)

N70-40269# Oak Ridge National Lab., Tenn.
SUMMARY OF ENVIRONMENTAL INFORMATION ACTIVITIES OF THE NUCLEAR SAFETY INFORMATION CENTER
William B. Cottrell and J. R. Buchanan Jun. 1970 72 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3009) Avail: NTIS

In order to provide vital information for the SEQUIP Committee (Study of Environmental Quality Information Programs sponsored by the Federal Government), the relevant activities of the Nuclear Safety Information Center are summarized. In so doing the scope and modus operandi of this sophisticated, widely diversified and computerized scientific information and analysis center are also outlined. Involved are over 30 scientists (avg halftime) and an expanding information base approaching 12,000 documents annually—approximately one-third of which (both men and documents) are concerned with environmental information. The resources, sources, operation, and services provided are discussed together with a commentary on all aspects of the Center's activities.
Author (NSA)

N70-40298# All American Engineering Co., Wilmington, Del.
LOW INERTIA TRANSMISSION STUDY, PHASE 2 Final Report
Linwood C. Robinson 25 May 1970 67 p
(Contract N00156-69-C-1897)
(AD-708760; AAE-N-586) Avail: NTIS CSCL 13/9

The feasibility of the use of the Low Inertia Transmission System (LITS) as an aircraft arresting gear was determined by performance analysis and testing of a small scale model of the system. The configuration of a capstan to be driven by steel cable, with reversing capability, was determined and a capstan model tested to prove the feasibility of the design. The design of a full scale capstan was made and the performance of a full scale system was determined using energy absorbers with torque as a function of angular velocity squared and with a constant torque function. Initial cable dynamic characteristics determined analytically are shown graphically for each torque characteristic. A scale model, using 3/8 inch diameter steel cable, of the complete low inertia transmission system, was tested as an arresting system. The results of this test give the time history from engagement to end of runout.
Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N70-39070 California Univ., Berkeley.
THE INTERACTION OF BUOYANCY, SHEAR, AND DIFFUSION IN STRATIFIED FLOWS
Hermann Eugenio Schwember (Ph.D. Thesis) 1969 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order 69-18967

The steady, two-dimensional diffusive mixing region of two laminar streams with different velocities and densities and subject to buoyancy with and without acceleration is studied; relevant parameters are determined, and solutions for velocity and density profiles are obtained. A nonlinear perturbation in a diffusive, two-dimensional, infinite fluid with stable, linear stratification and with linear shear is studied by means of an analytic approximation valid for small values of time. The solution obtained for the mixing region between two uniform streams shows that a self-similar solution for density exists if the convective effects can be represented by a linearized approximation of Oseen's type. The velocity profile is made up of a self-similar part independent of the effect of buoyancy and a distortion caused by buoyancy which grows downstream with the square root of the distance from the origin.
Dissert. Abstr.

N70-39087# Los Alamos Scientific Lab., N.Mex.
FLUID DYNAMICS: AN INTRODUCTORY TEXT
Francis H. Harlow and Anthony A. Amsden Feb. 1970 80 p refs
(Contract W-7405-eng-36)
(LA-4100) Avail: NTIS

This report presents a discussion of basic physical fluid dynamics, shows some useful techniques for obtaining solutions, and illustrates a variety of fluid flow phenomena by means of some solved problems. No prior fluid dynamics experience is required of the reader. Topics include derivation of the equations, an examination of their properties, a simplified discussion of molecular dynamics as related to fluid flows, a study of rarefactions and shocks, some compressible-flow solutions, some incompressible-flow solutions, and an introduction to numerical methods for high-speed computers.
NSA

N70-39160# Los Alamos Scientific Lab., N.Mex.
THE SMAC METHOD: A NUMERICAL TECHNIQUE FOR CALCULATING INCOMPRESSIBLE FLUID FLOWS
Anthony A. Amsden and Francis H. Harlow 17 Feb. 1970 85 p refs
(Contract W-7405-eng-36)
(LA-4370) Avail: NTIS

The Marker-and-Cell (MAC) method was previously proposed for the numerical solution of problems concerning the time-dependent, viscous flow of an incompressible fluid in several space dimensions. A simplified MAC (SMAC) method is described; it has at least as great a range of applicability as MAC, but is significantly simpler to use. The technique is presented in detail and illustrated by means of the flow diagram and FORTRAN listing of a computer program. Sample calculations are included, both as computer-generated pictures of results and as listings of a sample case.
Author

N70-39402*# TRW Systems Group, Redondo Beach, Calif.
MECHANICAL CONTROLS, NONMECHANICAL CONTROLS, AND TECHNOLOGY SUPPORT
In its Advanced Spacecraft Valve Technol. Jul. 1970 41 p refs
Prepared for JPL (See N70-39401 22-15)
Avail: NTIS CSCL 20D

Controls to be used with earth space storable propellants at pressures to 1,000 psia and operate reliably in the space environment for periods of up to ten years are studied for missions to the outer planets. The functional and environmental requirements are given, and the classes of controls considered are: (1) mechanical controls represented by those valves designed using moving mechanical elements, and (2) nonmechanical controls represented by a group of controls that use no moving parts and include the class of components defined as fluidics. The technology necessary to support the development of mechanical and nonmechanical controls is presented. This included propellant compatibility, seal, and leakage technology.
F.O.S.

N70-39436# Iowa State Univ. of Science and Technology, Ames.
EFFECT OF MASS TRANSFER ON THE MOTION OF A LIQUID-LIQUID INTERFACE
William Allen Scholle (Ph.D. Thesis) Feb. 1970 91 p refs
(Contract W-7405-eng-82)
(IS-T-387) Avail: NTIS

Pressure changes induced by a change in interfacial tension on the curved interface of a static drop were used to determine the driving force and subsequent motions of the droplet interface. At

any time, the drop was considered static with dynamic pressures imposed on it. These dynamic pressures included the interfacial tension change caused by solute spreading radially from the apex of the drop along the interface and the effect of a wave propagating from the apex. The interfacial tension change was achieved experimentally by introducing a tiny drop of a cyclohexanol solution to the apex of a cyclohexane or carbon tetrachloride drop which was resting on a flat plate immersed in water. High speed motion pictures of the dynamic drops and of the corresponding motion that occurred in a flat interface were taken. The mathematical model along with the boundary conditions measured from the pictures was used to calculate droplet shapes which compared favorably to actual droplet shapes. Author (NSA)

N70-39436*# Translation Consultants, Ltd., Arlington, Va.
EQUATIONS FOR A SEMIEMPIRICAL THEORY OF TURBULENT TRANSPORT [OB URAVNENIYAKH POLUEMPIRICHESKOY TEORII TURBULENTNOGO PERENOSA]
A. T. Onufriyev Washington NASA Sep. 1970 15 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 2, 1970 p 62–71
(Contract NASw-2038)
(NASA-TT-F-13219) Avail: NTIS CSCL 20D

A closed system of equations for the anisotropic nature of a flow is constructed on the assumption that the length of the mixing length is not short compared with the characteristic dimension of the flow. It is taken that the velocity pulsation field can be characterized by a multipoint distribution function satisfying the equation of continuity. This results in equations for single-point and double-point distribution functions. Author

N70-39684# Illinois Univ., Urbana. Coordinated Science Lab.
THE INTERNAL STRUCTURE OF SHOCK WAVES
Bruce L. Hicks, Shee-Mang Yen, and Barbara J. Reilly Jun. 1970 92 p refs
(Contracts DAAB07-67-C-0199; N00015-67-A-0305-0001)
(AD-707675; R-474; UILU-eng-70-219) Avail: NTIS CSCL 20/4

The non-linear Boltzmann equation was solved for shock waves in a gas of elastic spheres. The solutions were made possible by the use of Nordsiecks Monte Carlo method of evaluation of the collision integral in the equation. Accurate solutions were obtained by the same method for the whole range of upstream Mach numbers M from 1.1 to 10 even though the corresponding degree of departure from equilibrium varies by a factor greater than 1000. Many characteristics of the internal structure of the shock waves were calculated from the solutions and compared with Navier-Stokes, Mott-Smith and Krook descriptions which, except for low Mach numbers, are not based upon the Boltzmann equation itself. Author (TAB)

N70-39694# IIT Research Inst., Chicago, Ill. Dept. of Chemistry.
EFFUSION. 6: VELOCITY DISTRIBUTIONS OF GASEOUS CsCl FROM NEAR-IDEAL AND RIGHT-CIRCULAR CYLINDRICAL ORIFICES
K. C. Wang and P. G. Wahlbeck [1969] 40 p refs
(Contract AT(11-1)-1029)
(COO-1029-29) Avail: NTIS

Velocity distributions were measured for CsCl(g) effusing from double-oven effusion cells equipped with a near-ideal and non-ideal, right-circular cylindrical orifices. The back oven contained CsCl, and the front oven possessed an orifice. A multiple slotted-disk velocity selector was used to determine velocity distributions. The disks had slots cut at an angle to provide improved transmission. Detectors utilized surface ionization. Data were acquired for states of CsCl(g) ranging from the molecular flow region into the transition region and for several effusion angles. Author (NSA)

N70-39719*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LOW GRAVITY DRAINING FROM HEMISPHERICALLY BOTTOMED CYLINDRICAL TANKS Final Report
G. D. Bizzell, P. Concus, G. E. Crane, and H. M. Satterlee 1 Jun. 1970 134 p refs
(Contract NAS3-11526)
(NASA-CR-72718; LMSC-A903128) Avail: NTIS CSCL 20D

A finite difference technique utilizing an irregular triangular mesh is used to study tank draining in low gravity. Assuming that the liquid is inviscid and incompressible, that its motion is irrotational and axisymmetric, and that the solid-liquid contact angle maintains a constant value (5 deg), the initial boundary value problem is solved numerically for several values of Bond number, Weber number, initial fill level, and drain size. velocity field data, the evolution of free surface shapes with time, liquid residual volume, and time to vapor ingestion are presented. Comparisons with experimental data are favorable. Author

N70-39751# California Univ., Berkeley. College of Engineering.
ON THE STABILITY OF SHIP MOTION IN REGULAR OBLIQUE WAVES Technical Report, Jun. 1969–Jun. 1970
Mahmoud R. Haddara Jun. 1970 70 p refs
(Contract DOT-CG-84549-A)
(AD-708171; NA-70-2) Avail: NTIS CSCL 13/10

The nonlinear equations of motion of a ship sailing in regular oblique waves are formulated and an analytical method is developed to obtain an approximate solution for them. The stability of the steady-state solution is investigated by examining the behavior of the solution of the equations of the first variation of the equations of motion. The study shows that the existence of unstable motion is predicted for certain cases if we take account of nonlinearities in the equations of motion. This instability is very sensitive to variations in the nonlinear damping coefficient in roll. Author (TAB)

N70-39752# Southwest Research Inst., San Antonio, Tex.
EXPERIMENTAL DETERMINATION OF VARIATION OF HYDROFOIL FLUTTER SPEED WITH MASS RATIO Final Report, 1 Mar. 1969–31 Mar. 1970
Guido E. Ransleben, Jr. Apr. 1970 41 p refs
(Contract N00014-69-C-0219)
(AD-708061) Avail: NTIS CSCL 13/10

A description of the design and fabrication of a family of four hydrofoil flutter models is given. These models had identical geometric and elastic properties, differing only in mass ratio. The heaviest was a direct half-scale model of an earlier flutter model. A flutter point was approached to within an estimated 1/2 knot with the heavier model, and it was near the value predicted by scaling considerations. No flutter points were measured with the three remaining models, however, as the torsional divergence speed was lower than flutter speeds for them. This was rather unexpected, as the elastic axis was at the quarter-chord—usually considered to be far enough forward to ensure a high divergence speed. Author (TAB)

N70-39797*# Cornell Univ., Ithaca, N.Y.
BOUNDARY LAYER SEPARATION ON A LIQUID SPHERE
Brice Sumner and Franklin K. Moore Washington NASA Sep. 1970 31 p refs
(Grant NGL-33-010-042)
(NASA-CR-1669) Avail: NTIS CSCL 20D

An experimental investigation was made to determine what happens to the inside boundary layer of a liquid sphere in a steady, uniform stream at high Reynolds number when the outside boundary layer separates. The results indicate that the inside boundary layer remains attached despite the outside separation. A physical model for the liquid sphere flow is suggested, and the difficulties of a mathematical solution are discussed. Author

N70-39808# Central Electricity Generating Board, Berkeley (England). Research and Development Dept.
ANALYTICAL DESCRIPTION OF VAPOUR BUBBLE DYNAMICS IN WATER AND LIQUID SODIUM
R. B. Duffey Apr. 1969 29 p refs
(RD/B/N-1349) Avail: NTIS

The equations governing the dynamics of vapor bubbles in a liquid and their use in various models are examined. The limits of applicability of the equations and the restrictions implicit in the assumption thermal equilibrium are discussed in detail. The published results of previous models are reviewed, and the use of a general set of equations describing the dynamics of vapor bubbles is proposed. Author (NSA)

N70-39853# Naval Weapons Lab., Dahlgren, Va.
ON THE WAVE SURFACES OF A GAS IN MOTION
B. Zondek 17 Jun. 1970 29 p refs
(AD-708042; NWL-TR-2406) Avail: NTIS CSCL 20/4

Some of the mathematical tools needed for a theoretical study of the propagation of wavefronts in a gas in motion are derived. In mathematical terms, the study concerns itself with the characteristic manifolds of the partial differential equations governing gas dynamics in two spatial variables and the time; and also with the interior relations in these surfaces. Equations governing these wavefronts are derived, valid in four different coordinate systems -- plane Cartesian, cylindrical with axial symmetry, plane polar, spherical polar and axial symmetry. The interior relations are worked out in detail in one case. Author (TAB)

N70-39855# Iowa Univ., Iowa City. Inst. of Hydraulic Research.
FLOW OF DILUTE POLYMER SOLUTIONS IN ROUGH PIPES
Michael Poreh Apr. 1970 25 p refs
(Grant Nonr-1611(03))
(AD-708038; IIHR-126) Avail: NTIS CSCL 20/4

A simplified model is developed to describe the effects of boundary roughness on drag reduction achieved by polymer additives. The model is suitable for both uniform and nonuniform roughness. Predictions of friction coefficients by means of the model are in reasonable agreement with experimental results. Author (TAB)

N70-39901*# Scientific Translation Service, Santa Barbara, Calif.
CLOSED STREAMLINE, LOW MACH NUMBER FLOW OF A COMPRESSIBLE FLUID [ECOULEMENT A LIGNES DE COURANT FERMEES D'UN FLUIDE COMPRESSIBLE A FAIBLE NOMBRE DE MACH]
H. Viviand Washington NASA Sep. 1970 11 p refs Transl. into ENGLISH from Rech. Aerospatiale (Chatillon-sous-Bagneux), no. 1, Jan.–Feb. 1970 p 49–51
(Contract NASw-2035)
(NASA-TT-F-13257) Avail: NTIS CSCL 20D

The problem of a steady, non-viscous, low-Mach number flow with closed streamlines is solved. A generalized Bernoulli equation is derived. Author

N70-39908*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DECAY OF HOMOGENEOUS TURBULENCE FROM A GIVEN INITIAL STATE
Robert G. Deissler 1970 35 p refs Proposed for presentation at 23d Meeting of Div. Fluid Dyn., Charlottesville, Va., 23–25 Nov. 1970; sponsored by Am. Phys. Soc.
(NASA-TM-X-52883; E-5761) Avail: NTIS CSCL 20D

The homogeneous turbulence problem is formulated by first specifying the multipoint velocity correlations or their spectral equivalents at an initial time. Those quantities, together with the correlation or spectral equations are then used to calculate initial time derivatives of correlations or spectra. The derivatives in turn are used in time series to calculate the evolution of turbulence quantities with time. When the problem is treated in this way the correlation equations are closed by the initial specification of the turbulence and no closure assumption is necessary. An exponential series which is an iterative solution of the Navier-Stokes equations gave much better results than a Taylor power series when used with the limited available initial data. In general, the agreement between theory and experiment was good. Author

N70-40014# Naval Civil Engineering Lab., Port Hueneme, Calif.
THE TURBULENT FREE CONVECTION FLOW ABOVE A HEATED HORIZONTAL CIRCULAR PLATE
Tim Tse-Min Fu May 1970 200 p refs
(AD-707698; NCEL-TN-1079) Avail: NTIS CSCL 13/12

The turbulent free convection of air above a 2-foot diameter, heated horizontal plate was studied experimentally and numerically. The mean temperature fields and the indraft profiles for two mean plate temperatures were measured using a thermo couple and a constant temperature hot-wire anemometer. Also, the turbulence and mean velocity were measured for the higher plate temperature using the hot-wire method. The flow field was visualized by shadow photograph technique. From visualization and measurements, it was found that the region of significant deviation from ambient temperature and velocity was restricted to a region near the plate centerline (the primary flow region). The indraft velocity was found to be relatively large near the ground level (width approximately 1 in of the ground). The major temperature drop took place in the region very near the plate. Within 0.02 in of the plate the temperature distribution in the air could be calculated based on conduction only. This region was therefore, called the conduction layer. At a given mean plate temperature, the temperature gradient was found to increase with the radius. Data obtained from heat-transfer measurements were consistent with the one-third power correlation reported in the literature. Author (TAB)

N70-40027# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
COMPRESSIBLE TURBULENT PLANE COUETTE FLOW WITH VARIABLE WALL TEMPERATURE
Robert H. Korkegi and Ronald A. Briggs Mar. 1970 27 p refs
(AD-708162; ARL-70-0039) Avail: NTIS CSCL 20/4

Equations describing compressible turbulent plane Couette flow for the general case of arbitrary wall enthalpy have been developed for a perfect gas based on the von Karman mixing length model. The procedure used was to obtain the velocity distribution near each wall and determine the matching point of the two profiles by the requirement that the velocities and their slopes must be equal at this point. Sample results are given in terms of the influence of heat transfer on velocity, enthalpy, and skin-friction distributions. Author (TAB)

N70-40103# Hydronautics, Inc., Laurel, Md.
GRAVITY FLOW PAST A CYLINDER MOVING BENEATH A FREE-SURFACE
G. Dagan Jun. 1970 45 p refs
(Contract Nonr-3349(00))
(AD-707723; TR-117-16) Avail: NTIS CSCL 20/4

The gravity flow past a cylinder moving close to a free-surface at high Fr is investigated by the method of matched asymptotic expansions. The inner flow model is that of a nonseparated non-linear gravity-free flow past a doublet. Author (TAB)

N70-40104# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
ON THE REFLECTION OF A SHOCK WAVE FROM A WALL
Manuel D. Salas May 1970 40 p refs
(Contract Nonr-839(34))
(AD-707716; PIBAL-70-23) Avail: NTIS CSCL 20/4

The one-dimensional Navier-Stokes equations are used to compute the unsteady structure of a shock wave reflecting from a wall. The shock wave is created by the accelerated motion of a piston into a gas initially at rest. The equations are solved by means of a time-dependent finite difference, second-order accurate scheme. A variable mesh is used to increase the accuracy of the computation and reduce the computation time. Results are presented for both an isothermal and an adiabatic wall. The technique is applicable to flows with Reynolds number between 10 and 1000. Author (TAB)

N70-40107# California Univ., Berkeley. Div. of Aeronautical Sciences.

THEORETICAL INVESTIGATION OF SUPERSONIC LAMINAR SEPARATION IN A CONCAVE CORNER

Tsai An Lu Mar. 1970 74 p refs

(Grant AF-AFOSR-268-67)

(AD-707850; AS-70-2; AFOSR-70-1692TR) Avail: NTIS CSCL 20/4

Separation and reattachment of a supersonic laminar boundary layer in a concave corner, due to a free interaction process, are investigated by the method of integral relations. The proposed total enthalpy profile, which is represented as a polynomial in the streamwise velocity component, can satisfy all the physical conditions in the attached and separated regions. As a result, the effect of wall cooling together with suction can be studied within a single framework. The solution runs smoothly through the separation and reattachment points without any difficulties. The numerical results contain all the known physical characteristics associated with laminar separation. A critical point is found downstream of the reattachment point. This provides a criterion for determining the initial point of the interaction region. A new computational procedure is suggested after careful consideration of the nature of this critical point. The integral curve which leads away from the critical point will be matched with the curve originating at the initial interaction point ahead of the corner. In this way smooth continuation of the boundary layer displacement thickness is made possible. The present method appears to be simpler, more direct, and more versatile than many existing integral methods. Its extension to apply to a wider class of problems is under consideration. Author (TAB)

N70-40124* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LOW VISCOSITY MAGNETIC FLUID OBTAINED BY THE COLLOIDAL SUSPENSION OF MAGNETIC PARTICLES

Patent

Solomon Stephen Papell, inventor (to NASA) Issued 2 Nov. 1965 (Filed 9 Oct. 1963) 5 p Cl. 149-2

(NASA-Case-XLE-01512; US-patent-3,215,572; US-Patent-Appl-SN-315096) Avail: US Patent Office CSCL 20D

A method is described for obtaining a low density and low viscosity magnetic propellant usable under zero-gravity conditions. The magnetic particles are dispersed throughout the propellant and colloidally suspended by utilizing particles of submicron size, so that the surface area of each particle is extremely large in relation to its mass. Because of the small particle size and large surface area, the particles attract and hold the molecules of propellant by surface tension or by adsorption. Because of the relatively small amount of magnetic material present, the propellant forms the major constituent of the colloid which provides viscosity, continuous flow, and low energy penalty due to the introduction of noncombustible particles. R.B.

N70-40146# Aerospace Corp., El Segundo, Calif. Lab. Operations.

SHOCK TUBE STUDIES USING IMAGE ORTHICON SPECTROSCOPY Technical Report, Nov. 1968 – Apr. 1969

Edward W. Hewitt, Jerry F. Bott, and Theodore A. Jacobs 30 Apr. 1970 18 p refs

(Contract F04701-69-C-0068) (AD-707841; TR-0066(5816-36)-2; SAMSO-TR-70-204) Avail: NTIS CSCL 14/2

An image orthicon detection and recording system was adapted for making spectroscopic measurements in shock tube emission studies. The system provides greater sensitivity than film and permits electronic control of both the timing and the duration of the exposure. The linear response with light intensity and the immediate recording of the output on an oscilloscope trace make the system a convenient diagnostic tool. A description of the system as well as quantitative spectroscopic data obtained with it are presented. Author (TAB)

N70-40162# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.

HYPERSONIC WAKE STUDIES Final Report, 15 Jan. 1962 – 15 Jan. 1970

Seymour M. Bogdonoff 10 Jul. 1970 21 p refs

(Contract Nonr-1858(37); ARPA Order 322) (AD-708757) Avail: NTIS CSCL 20/4

Contents: Two-dimensional wakes; Magnetic suspension system - hypersonic tunnel development; Sphere wakes; Transition studies; Sharp and blunt cone wakes; Low density studies; Surface and base geometry effects on the wake; Wire support effects; Effects of Mach number, Reynolds number and surface temperature; Two-dimensional wakes; Magnetic suspension system; Hypersonic tunnel development; Study of sphere wakes; Study of sharp cone wakes; Study of blunt cone wakes; Other cone studies; Preliminary results of high Reynolds number; Other incompleted studies. TAB

N70-40164# Massachusetts Inst. of Tech., Cambridge. Heat Transfer Lab.

REFRIGERANT FORCED-CONVECTION CONDENSATION INSIDE HORIZONTAL TUBES

Soonhoon Bae, John S. Maulbetsch, and Warren M. Rohsenow 1 Nov. 1969 121 p refs Sponsored by Am. Soc. of Heating, Refrig. and Air Conditioning Engr.

(DSR-79760-64) Avail: NTIS

High vapor velocity condensation inside a tube was studied theoretically. The heat transfer coefficients were calculated by the momentum and heat transfer analogy. The Von Karman universal velocity distribution was applied to the condensate flow. Pressure drop was calculated by the Lockhart-Martinelli method and the Zivi void fraction equation. Experimental data were obtained for the flow rate from 240,000 to 485,000 lbm/sq ft hr. R-22 was condensed in a 0.493 in. I.D. 18 ft long test section. The measured heat transfer coefficients agreed with the prediction within 10% except for a few points in the very low quality region. Author

N70-40166# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

NONLINEAR EFFECTS IN THE COLLAPSE OF A NEARLY SPHERICAL CAVITY

Richard B. Chapman and Milton S. Plesset Jul. 1970 19 p refs

(Contract N00014-67-0094-0009) (AD-708768; Rept-85-51) Avail: NTIS CSCL 20/4

A linearized perturbation theory was developed some time ago for the analysis of the growth of distortions in a nearly spherical cavity collapsing in a liquid. Since the distortions grow as the cavity collapses, it is of importance to determine the validity of the linearized approximation. The study gives a numerical solution of the exact nonlinear equations for the growth of a distortion. Two kinds of distortions are studied in detail: Case A is essentially a prolate ellipsoid; Case B is essentially an oblique ellipsoid. Both cases have initial large deformations from the spherical shape. The numerical solution shows that the linearized perturbation approximation remains surprisingly accurate through most of the

cavity collapse. The principal effect of the nonlinear calculation is in the coupling of the various distortion modes. Author (TAB)

N70-40262# North American Rockwell Corp., Downey, Calif. Space Div.
HYDROELASTIC ANALYSIS OF A CIRCULAR CYLINDER/LIFT ON BODIES OF REVOLUTION Final Report
Howard D. McLaughlin and Ben H. Ujihara Dec. 1969 350 p refs
(Contract N00014-68-C-0223)
(AD-708434; SD-69-558) Avail: NTIS CSCL 20/4

Potential theory is applied to numerical solution of non-steady, separated flows about cylindrical bodies. The particular configurations studied are (1) an elastically supported circular cylinder in uniform onset flow and (2) a growing elliptical cylinder representing, in the cross flow plane, a slender body at angle of attack. Solution of non-steady, separated flows by potential theory is made possible by a generalization of the Kutta-Joukowski Condition to govern the rate of vorticity transport from the attached boundary layer into the near wake. This vorticity is represented by incremental, discrete particle vortices. Both theory and numerical results are presented. For the elastically supported circular cylinder, the natural frequency is taken to be the Strouhal frequency. Instantaneous pressure distributions, and force time histories are shown. For slender bodies at angle of attack, lift distributions, force and moment coefficients are presented for a body of revolution with length-diameter ratios of 10 at various angles of attack. Detailed separated flow stream lines are also shown. Author (TAB)

N70-40258# Naval Ship Research and Development Center, Washington, D.C.
INTEGRAL METHODS FOR TURBULENT BOUNDARY LAYERS IN PRESSURE GRADIENTS Final Report
Paul S. Granville Apr. 1970 55 p refs
(AD-707074; NSRDC-3308) Avail: NTIS CSCL 20/4

Shape parameter differential equations are developed for turbulent boundary layers in pressure gradients incorporating two-parameter velocity profiles. Energy and entrainment methods are included. Shear stress factors are explicitly developed for equilibrium and quasi-equilibrium conditions. Author (TAB)

N70-40279# Naval Ship Research and Development Center, Washington, D.C.
THE EFFECT OF WALL POROSITY ON THE STABILITY OF PARALLEL FLOWS OVER COMPLIANT BOUNDARIES
Harvey W. Burden Feb. 1970 172 p refs
(AD-707076; NSRDC-3330) Avail: NTIS CSCL 20/4

An analytical investigation is made of the effect of wall porosity upon the stability of quasi-parallel laminar flows along plain compliant boundaries of several types. A numerical technique is employed for solution of the coupled Orr-Sommerfeld/stress-strain/strain rate equations for incompressible, viscous fluid flowing over a porous, compliant, visco-elastic boundary. The analytical and numerical methods are described in detail. The results are compared with those of comparable situations without porosity, which, in turn, are compared with results of previous investigations, both analytical and empirical. Spatial amplification rates, velocity perturbation profiles, and Reynolds stress profiles are shown for a selected number of conditions. Basic analysis is presented for the case of parallel flow through a uniform circular cylindrical tube with similar wall characteristics. Numerical results are not presented; however, the direction of such future investigation is indicated. Author (TAB)

N70-40312# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A DISCUSSION OF APPROXIMATE THEORIES FOR INVISCID HYPERSONIC FLOW ON CONCAVE SURFACES
P. A. Sullivan Jun. 1970 60 p refs
(AD-708823; UTIAS-140) Avail: NTIS CSCL 20/4

The work examines the applicability of the well known approximate inviscid theories for estimating surface pressure on sharp leading edged bodies in hypersonic flow to concave surfaces, for the particular case when there is only a single shock wave attached to the leading edge. It is shown that the various methods give widely differing estimates. Some exact limiting self-silimar solutions are used to show that the waves reflected off entropy lines and the shock are very important. The thin shock layer theory, for which the Newtonian plus centrifugal theory is the first approximation, is shown to give a fairly good estimate of the centrifugal pressure rise across the layer. A combined tangent wedge plus centrifugal rule is proposed to overcome the major objection to the thin shock layer theory, which is seriously inaccurate near the leading edge because of the failure of the strong shock approximation. Author (TAB)

N70-40349# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE POSITION OF THE STAGNATION POINT IN THREE-DIMENSIONAL HYPERSONIC FLOW AROUND SEGMENTAL BODIES
B. A. Zemlianskii [1970] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 1, 1970 p 164–168
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The position of the stagnation point in hypersonic flow around a spherical segment at an angle of attack close to the half angle depends strongly on the thermodynamic state of the gas behind the detached shock. It is shown that the spacing between the stagnation point and the closest point of the edge of the segment is proportional to $k(1/2)R$ for an equilibrium gas with $k << 1$, where k is the ratio between the free stream gas density and the density behind a normal shock, and R is the radius of curvature of the segment. Author

N70-40350# Lockheed Missiles and Space Co., Palo Alto, Calif.
SUPERSONIC GAS FLOW AROUND A CONE AT AN ANGLE OF ATTACK
M. M. Vasilev [1970] 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 1, 1970 p 33–39
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A solution is obtained of the problem of supersonic flow around an infinite circular cone taking account of terms O(epsilon squared), where epsilon is the ratio of the angle of attack to the cone half-angle. In contrast to the known Stone solution, higher order infinitesimal terms than the main terms are retained in the entropy conservation equation, which permits assurance of the correct behavior of the entropy and some associated functions in the whole stream, including the vortex layer. Results of numerical computations are compared with the Stone solution and a solution by the mesh method. Author

N70-40352# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ANALYSIS OF TRANSONIC FLOW AROUND BODIES OF REVOLUTION
Iu. M. Lipnitskii et al [1970] 6 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 34, no. 3, 1970 p 508–513
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A numerical scheme for solving gas dynamics problems by the method of build-up is expounded which is suitable for the analysis of transonic flows around bodies of revolution. After a brief description of the computational procedure, results are presented of computations of the flow around a sphere, an ellipsoid, a combination of a sphere and cylinder of different span, and a combination of a sphere and cone for different supercritical Mach numbers. The Mach number level lines constructed illustrate the

flow in the local supersonic zones, their configuration and change, and the position of the compression shocks. Author

N70-40380# Colorado State Univ., Fort Collins. Engineering Research Center.
GASEOUS PLUME DIFFUSION ABOUT ISOLATED STRUCTURES OF SIMPLE GEOMETRY Annual Progress Report, 14 Jun. 1969 – 14 Jun. 1970
Robert N. Meroney Mar. 1970 18 p
(Contract AT(11-1)-2053)
(COO-2053-1) Avail: NTIS

A model was constructed to perform geometrically and dynamically similar experiments for diffusion of gases in building wakes in the atmosphere and in the meteorological wind tunnel. Kr-85 was used as a tracer gas for obtaining concentration distributions. Dispersion of the gas was affected by the aerodynamic structure of the flow and the temperature stratification condition. Photographs showed a strong mixing in the cavity region and a turbulent mixing motion was dominant in the wake region. The apparatus allowed different places for release of the smoke, and similar contours of concentration distribution showed no effect of the release location. The stable stratified flow suppressed the turbulent motion and resulted in higher concentrations at a given down wind distance. NSA

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N70-39009# Asian Inst. of Tech., Bangkok (Thailand).
PATTERN FORMING FORCES IN DELTAS
Catalino del Rosario dela Cruz (M.S. Thesis) 1969 92 p refs
(Thesis-275) Avail: NTIS

A number of deltaic plains, built out by sediments transported to the coast by rivers, was studied. Special consideration was given to their distinct patterns and the causative independent variables, namely: river, ocean, and climatic forces. Regression analysis was used in obtaining predictive equations for discharge and sediment yield as a function of catchment characteristics. From the chosen variables, the following showed best correlation: mean annual rainfall and area for the discharge; and percentage of mountainous area, relief, area, and perimeter for the sediment yield. These equations were used to provide data for discharge and sediment yield of other rivers where the information was not otherwise available. Author

N70-39018# Asian Inst. of Tech., Bangkok (Thailand).
EQUILIBRIUM SHAPES OF COASTLINE IN PLAN
Narongsak Vichetpan (M.S. Thesis) 1969 60 p refs
(Thesis-280) Avail: NTIS

A straight sedimentary coastline containing headlands, if it suffers persistent waves from an oblique direction and no replenishment is provided for material removed down coast, will assume a crenulate shape which becomes progressively more indented. Finally a shape is reached which is in equilibrium with the waves. This occurs when the incoming waves break simultaneously around the periphery and there is no further longshore drift. The development of such equilibrium shaped bays was studied by means of a model in which wave direction and wave periods were the sole variables. Thus the wave height, water depth, beach height and sedimentary material were the same throughout. The shape of the bay at various stages from straight line to fully stable was measured after various wave durations. It was found that the major curved portion of the water line was a logarithmic spiral, the constant of which varied throughout. A consistent pattern was observed for this constant for the three wave approach angles of 30 deg, 45 deg, and 60 deg and the three wave periods of 0.6, 1.0 and 1.4 seconds. Author

N70-39042 Polytechnic Inst. of Brooklyn, N.Y.
RANDOM PROCESSES FOR EARTHQUAKE SIMULATION
Roy Levy (Ph.D. Thesis) 1969 194 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-17793

The criteria presented for evaluation of digital computer processes to simulate strong-motion western United States earthquakes are based upon hypothetical autocovariance functions for the ground acceleration, maximum values of ground acceleration, spectra for oscillator response, and nonstationarity of ground acceleration and velocity. The criteria are applied to four specific simulation processes that are examined by means of both theoretical and simulated results. Empirical relationships, simplified computational methods, graphical data, and examples are presented to expedite the construction of simulation models of other types of earthquake phenomena and additional forms of transient loading. Related mathematical definitions from the fields of probability theory and random processes, discussions of the effect of variations in the simulation duration time and time increment, and illustrations of structural response of simplified analytical models of structures to simulated earthquakes are also presented. Dissert. Abstr.

N70-39048# Department of Energy, Mines and Resources, Ottawa (Ontario). Observatories Branch.
RECORD OF OBSERVATIONS AT FORT CHURCHILL MAGNETIC VARIOMETER STATION, 1967
G. Jansen van Beek 1970 75 p refs *Its* Publ. of the Dominion Obs., Ottawa, Vol. 39, No. 8
Avail: NTIS

Hourly and mean values of the magnetic components are tabulated. These include the hourly values of the north and east components of horizontal intensity and the vertical intensity; mean values of the elements on all days, quiet days, and disturbed days; and the hourly ranges of the east and north components. N.E.N.

N70-39080 California Univ., Berkeley.
SPHERICAL HARMONIC ANALYSIS OF PALEOMAGNETIC DATA
John Maurice Wells (Ph.D. Thesis) 1969 329 p
Avail: Univ. Microfilms: HC $14.85/Microfilm $4.25 Order No. 69-18988

The best fitting sets of spherical harmonic coefficients (up to $n = 3$) for each time span were determined by minimizing a function of the difference between observed and predicted paleomagnetic directions. This analysis is complicated by the nonuniform distribution of observations in time and space and which are also subject to uncertainty. Since the function to be minimized is nonlinear in the 14 desired coefficients, three approximation methods were used. The first method (steepest descent) is slow but sure. In this method, the function is expanded in a Taylor series to the second order. The second method (modified steepest descent) estimates the relative change in each variable by fitting a parabola through three adjacent points along the steepest part of the surface and moving to the minimum of this parabola. The third method increments a particular coefficient until a local minimum is found. Dissert. Abstr.

N70-39148# Oregon State Univ., Corvallis.
NEUTRON ACTIVATION ANALYSIS FOR CORRELATING VOLCANIC ASH SOILS
Glenn Arnold Borchardt (Ph.D. Thesis) Jun. 1970 219 p refs
(Contract AT(45-1)-2062)
(RLO-2062-6) Avail: NTIS

The objectives of this study were: to determine trace element differences between sample sites and between deposits of Mazama, Newberry, Glacier Peak, and St. Helens volcanic ash in the Pacific Northwest; to correlate volcanic ash in peat bogs with volcanic ash from upland sites; to verify Mazama ash as parent material of soils occurring along a 450 km transect in Oregon; and to determine the trace element composition of clays derived from volcanic ash. Samples were irradiated in a TRIGA Reactor, followed by detection of elements with a high-resolution 30-cc Ge(Li) semiconductor detector and a 4096-multichannel analyzer. Gamma spectra were analyzed with a computer program. Field variability of Mazama and Newberry ash deposits in Oregon was about 5%, whereas the variability of the crystal-rich Glacier Peak and St. Helens ash of Washington was greater. The trace element compositions of volcanic glass from C horizons of soils along a 450-km transect in Oregon correlate with ejecta from Mt. Mazama. Author (NSA)

N70-39189 Washington Univ., Seattle.
A THERMODYNAMIC MODEL OF SEA ICE
Gary Allen Maykut (Ph.D. Thesis) 1969 214 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-18300

A one-dimensional thermodynamic model of sea ice is presented, which includes the effects of snow cover, ice salinity, and internal heating due to penetration of solar radiation. Surface energy balances determine rates of ablation and accretion and diffusion equations govern heat transport within the ice and snow. The incoming radiative and turbulent fluxes, oceanic heat flux, ice salinity, snow accumultion, and surface albedo are specified as functions of time. Starting from an arbitrary initial condition, the model is integrated numerically until annual equilibrium patterns of temperature and thickness are achieved. The model neglects the effects of mechanical stresses on the idea and the influence of surface conditions on the turbulent fluxes. Leads and melt ponds are considered only insofar as they indirectly affect the energy fluxes over the bare ice. The model is applied to the Central Arctic. Dissert. Abstr.

N70-39237*# Translation Consultants, Ltd., Arlington, Va.
GRAVIMETRY AT THE BELGIAN ROYAL OBSERVATORY [LA GRAVIMETRIE A L'OBSERVATOIRE ROYAL DE BELGIQUE]
B. Ducarme Washington NASA Sep. 1970 24 p refs Transl. into ENGLISH from Ciel Terre (UCCLE), v. 86, no. 2, 1970 p 1–20 *Its* Commun., Ser. B, No. 51; *Its* Geophys. Ser. No. 97
(Contract NASw-2038)
(NASA-TT-F-13223) Avail: NTIS CSCL 08E

The earth's gravity field is examined according to three main topics: absolute measurement, variations at the surface, and periodic changes of g under the action of the sun and moon. These gravimetric tides have been studied since the I.G.Y. in connection with the internal constitution of the earth. Author

N70-39243*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOMAGNETIC MODELS FROM SATELLITE SURVEYS
Joseh C. Cain Jul. 1970 36 p refs Submitted for publication
(NASA-TM-X-65324; X-645-70-263) Avail: NTIS CSCL 08N

Spacecraft experiments measuring magnetic field from a low altitude (below 1500 km) are assessed to determine how well the data have been used to determine numerical models of the internal geomagnetic field. The evidence indicates that surface surveys are no longer needed for defining the broad features of the main field and following secular change. As expected, spacecraft observations are much more comprehensive and quickly obtained, and result in models with higher accuracy. Author

N70-39261# California Univ., Berkeley.
SEISMIC RESPONSE OF SOIL DEPOSITS UNDERLAIN BY INCLINED BOUNDARIES
Houshang Dezfulian (Ph.D. Thesis) 1969 214 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-18907

The influence of the rock slope was shown to extend sometimes to as far as 12 times the maximum thickness of the deposit beyond the toe of the rock slope. The extent and the magnitude of the influence was shown to be essentially a function of the combined action of the base slope angle, the maximum thickness of the deposit, the strain-dependent soil properties, and the amplitude and frequency characteristics of the base motion. A method was developed which with the help of diagrams might be used to evaluate the response of soil deposits having inclined rock surfaces by means of a series of semi-infinite solutions. The proposed technique as compared to a finite element method of response analysis is simpler, less expensive, does not require a large-capacity computer, and is reasonably accurate. Finally, the influence of the spatial variations of a traveling wave on the response of a soil deposit was shown to be significant only for low ranges of wave propagation velocities. Dissert. Abstr.

N70-39303*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ALTITUDE VARIATION OF ION COMPOSITION IN THE MIDLATITUDE TROUGH REGION: EVIDENCE FOR UPWARD PLASMA FLOW
Henry C. Brinton, Joseph M. Grebowsky, and Hans G. Mayr Aug. 1970 25 p refs Submitted for publication
(NASA-TM-X-65328; X-621-70-311) Avail: NTIS CSCL 04A

Midday ion composition measurements made by the Explorer 32 ion mass spectrometer in the midlatitude trough region (L = 5.0 – 10.5) are compared with measurements made within the plasmasphere (L = 1.8 – 2.2). In the trough the light ion (H(+) and He(+)) concentrations are observed to decrease with altitude between 600 and 2500 km – a region in which O(+) is the major ion. Within the plasmasphere, however, the concentrations of the light ions, when minor, increase with altitude. Model calculations indicate that the behavior of the plasmasphere profiles is consistent with a state of stationary diffusive equilibrium, whereas a dynamic plasma state is required to account for the trough distributions. Upward directed H(+) fluxes having near sonic speeds above 2000 km are required to reproduce the measured trough variations. This trough wind, consisting of a rapid upward flow of H(+), can be interpreted as evidence for the convection of the supersonic polar wind onto closed trough field lines. Author

N70-39324# Geological Survey, Washington, D.C.
AERORADIOACTIVITY SURVEY AND RELATED SURFACE GEOLOGY OF THE CHICAGO AREA, ILLINOIS AND INDIANA (ARMS-1)
George M. Flint, Jr. and James A. Pitkin Jun. 1970 25 p refs Prepared in cooperation with AEC
(CEX-59.4.13) Avail: NTIS

An aeroradioactivity survey of the Chicago area, Illinois and Indiana, was made in 1960 by the U. S. Geological Survey for the U. S. Atomic Energy Commission. Continuous radioactivity profiles were obtained with scintillation-counting equipment at approximately 500 feet above the ground on parallel east-west flight lines spaced 1 mile apart. A map of aeroradioactivity units was prepared from the profiles. The gamma radiation data indicate a moderate range in the levels of natural radioactivity and only a very general correlation with the surface geology. The entire area surveyed is covered by glacial deposits and loess of Pleistocene age. Bedrock exposures of the underlying sedimentary rocks of Cambrian through Pennsylvanian age are sparse. Distinct radioactivity lows

are associated with areas of sand (outwash deposits) in the eastern part of the area surveyed. Elsewhere only correlations are made with the glacial morainal, drift, and lacustrine deposits.
Author (NSA)

N70-39391# Oregon State Univ., Corvallis.
MINEROLOGY AND TRACE-ELEMENT COMPOSITION OF ASH AND PUMICE SOILS IN THE PACIFIC NORTHWEST OF THE UNITED STATES
M. E. Harward and G. A. Borchardt [1969] 13 p refs Presented at the Panel on Volcanic Ash Soils in Latin Am., Turrialba, Costa Rica
(Contract AT(45-1)-2062)
(RLO-2063-4; CONF-690721-1) Avail: NTIS

Investigations are in progress to characterize the trace element composition of volcanic glass by use of instrumental neutron activation analysis. Abundances of 19 nuclides belonging to the alkali and alkaline earths, rare earths, and transition metals are obtained directly with this technique. The trace element composition of glass was shown to be consistent within given deposits and to differ between sources. Weathering affects of the composition of some elements, particularly the transition elements, but there appears to be little effect on the contents of rare earths. Trace element analyses determined by neutron activation are useful in investigations of depth of weathering, nature of alteration products, and profile discontinuities as well as for identification of the ash layers being investigated.
Author

N70-39408# Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 235 27 Aug. 1970 p 11–18 refs (See N70-39405 22-34)
Avail: NTIS

Investigations of Soviet research vessels are discussed, along with synchronous observations of currents in the Atlantic Ocean. A book review is presented on Soviet oceanographic expeditions including significant results. Abstracts on various oceanographic literature are also cited.
J.A.M.

N70-39409# Joint Publicatiions Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 235 27 Aug. 1970 p 19–25 refs (See N70-39405 22-34)
Avail: NTIS

Secular variation of magnetic field anomalies, seismomagnetism, earth heat regime, and compilation of gravimetric, magnetometric, tectonic, and geomorphological maps of Armenia are reviewed. Earthquake intensity and destruction in Kirgiz from June 5 to 9 are examined. Seismeic microzoning, and a field manetotelluric station are described, as well as the upper mantle program. Abstracts on various geophysical literature are also included.
J.A.M.

N70-39410# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 235 27 Aug. 1970 p 26–31 refs (See N70-39405 22-34)
Avail: NTIS

Weather forecasting using satellite photography is reviewed, and the launching of Cosmos 354 on July 29, 1970 is announced. Abstracts on various atmospheric and aerospace literature are also included.
J.A.M.

N70-39433# Woods Hole Oceanographic Institution, Mass.
THE DISTRIBUTION OF SOME CHEMICAL ELEMENTS BETWEEN DISSOLVED AND PARTICULATE PHASES IN THE OCEAN Progress Report, 1969–1970
Derek W. Spencer, Peter G. Brewer, Peter L. Sachs, and C. L. Smith 1970 69 p refs
(Contract AT(30-1)-4150)
(NYO-4150-2) Avail: NTIS

All phases of research during the year 1969-70 are summarized. Five topics are reported: (1) trace elements in Black Sea waters, (2) suspended matter in the Black Sea, (3) suspended matter between Cape Cod and Cape Hatteras, (4) trace element intercalibrations (GEOSECS), and (5) neutron activation analysis of suspended matter in ocean water.
Author

N70-39542# Air Force Cambridge Research Labs., Bedford, Mass.
IMPROVEMENT OF THE GEOS-1 NORTH AMERICAN TRACKING NETWORK FROM MULTIPLE SHORT ARC GEODETIC ADJUSTMENTS
George Hadgigeorge Feb. 1970 167 p refs
(AD-707870; AFCRL-70-0090; AFCRL-ERP-315) Avail: NTIS CSCL 17/8

Combinations of 171 passes were employed in a short arc geodetic adjustment to improve the survey coordinates of 29 observing stations. The recovery of the station positions and their standard errors along with other geodetic parameters are presented. The results of the adjustment show a mean standard error of approximately 3.5 meters, and corrections to NAD survey coordinates basically consistent with the observation network with the origin at Hunter AFB.
Author (TAB)

N70-39663# Alaska Univ., College. Geophysical Inst.
CRUSTAL MORPHOLOGY OF CENTRAL ALASKA
John N. Davies (M.S. Thesis) May 1970 67 p refs
(Contract F44620-68-C-0066; Grant NSF GA-1566)
(AD-707885; AFOSR-70-1694TR) Avail: CFSTI CSCL 8/7

In July 1968 five temporary seismic stations were installed in central Alaska to augment the existing stations of the Seismology Laboratory of the University of Alaska. These stations, along with several stations of the United States Coast and Geodetic Survey, were utilized in a crustal study wherein the energy source was earthquakes. This method of study is suited to central Alaska because of its high seismicity and sparce road system. Apparent velocities were calculated between each pair of stations for which there was adequate data. Assuming a standard crust-mantle velocity contrast the dip of the Moho was calculated. The resulting depth distribution is generally consistent with isostacy, however, significant anomalies are explained by sea-floor spreading in the Gulf of Alaska.
Author (TAB)

N70-39744# Utah Univ., Salt Lake City. Upper Air Research Lab.
ROCKET INSTRUMENTATION FOR THE STUDY OF A POLAR CAP ABSORPTION EVENT, PCA-69 Final Report, 29 Mar. 1967–31 Mar. 1970
Kay D. Baker, David A. Burt, L. Carl Howlett, and Glenn D. Allred Apr. 1970 207 p refs Sponsored in part by DASA
(Contract F19628-67-C-0275)
(AD-708135; UARL-UU-70-2; AFCRL-70-0251) Avail: NTIS CSCL 4/1

An ionospheric measurements program (PCA-69), utilizing 41 scientifically instrumented, sequentially launched rockets, was conducted from the Churchill Research Range, Manitoba, Canada. The purpose of the program was to obtain measurements of ionospheric parameters and ionizing input fluxes during a polar cap absorption event. The event investigated occurred on 2, 3, and 4 November 1969, and produced initial levels of absorption ranging

to >15 db with subsequent lower levels during its decay. A large portion of the instrumentation of 15 of the 41 rockets was provided by Upper Air Research Laboratory, University of Utah under Contract F19628-67-C-0275. This report describes that instrumentation, provides instrument specifications, and gives a general overview of the entire program and its history. Author (TAB)

N70-39782# Naval Oceanographic Office, Washington, D.C.
INSTRUCTION MANUAL FOR OBTAINING OCEANOGRAPHIC DATA (THIRD EDITION)
1970 59 p
(AD-708318; NOO-Pub-607-Change-1) Avail: NTIS CSCL 8/10

Contents: Oceanography; Meteorological, sea and swell, and special observations; Measuring water temperature and depth with a bathythermograph; Nansen bottles and reversing thermometers. Taking an oceanographic station; Sheet computations; Manipulating reversing thermometer malfunctions; The shipboard chemistry laboratory. Salinity determination of sea water samples; Dissolved oxygen content determination of sea water samples; Phosphate, silicate, pH, and alkalinity determination of sea water samples; Bottom sediment sampling. Current measurements; Underwater photography; Biological sampling, Navigation and sonic soundings; Sonar pinger; Oceanographic station summary and plotting sheets; Seismic profiling systems; AGODDS system; and Shipboard survey system W, X, Y, Z. TAB

N70-39798# Joint Publications Research Service, Washington, D.C.
HYDROPHYSICAL TECHNIQUES AND EQUIPMENT
28 Aug. 1970 33 p refs Transl. into ENGLISH from Metodika i App. dlya Gidrofiz. Issled. (Kiev), v. 41, 1969 p 3–17; 164–180
(JPRS-51272) Avail: NTIS

CONTENTS:

1. IMPROVEMENT OF TECHNICAL EQUIPMENT FOR HYDROPHYSICAL RESEARCH A. G. Kolesnikov et al p 1–15 refs (See N70-39799 22-13)

2. CONTROLLED COMPLEX OF A TOWED HYDROPHYSICAL APPARATUS A. N. Paramonov et al p 16–31 refs (See N70-39800 22-13)

N70-39799# Joint Publications Research Service, Washington, D.C.
IMPROVEMENT OF TECHNICAL EQUIPMENT FOR HYDROPHYSICAL RESEARCH
A. G. Kolesnikov et al *In its* Hydrophys. Tech. and Equipment 28 Aug. 1970 p 1–15 refs (See N70-39798 22-13)
Avail: NTIS

Problems in automating acquisition, transmission, and processing of hydrophysical data are discussed. The characteristics of automated data systems for collection and processing of oceanographic data are presented and shipboard systems currently in use or under development are described. R.B.

N70-39800# Joint Publications Research Service, Washington, D.C.
CONTROLLED COMPLEX OF A TOWED HYDROPHYSICAL APPARATUS
A. N. Paramonov et al *In its* Hydrophys. Tech. and Equipment 28 Aug. 1970 p 16–31 refs (See N70-39798 22-13)
Avail: NTIS

A controlled towed device designed for measurement of temperature, salinity, hydrostatic pressure, and the vertical temperature gradient at speeds up to 12 knots is described. The control system for the deivce prcvides for three modes of operation: tracking to a given depth, surfacing, and tracking along a given isotherm. The signal spectrum at the towed transducer output is estimated by the Taylor hypothesis. R.B.

N70-39813# Joint Publications Research Service, Washington, D.C.
NEED FOR GREAT ADVANCES IN GEODETIC WORK
H. Peshel *In its* Transl. on Eastern Europe Sci. Affairs, No. 131 16 Sep. 1970 p 8–16 Transl. into ENGLISH from Vermessungstechnik (East Berlin), Jun. 1970 p 201–205 (See N70-39811 22-34)
Avail: NTIS

A historical review is given on the development of geodesy during the past 90 years and forecasts are made on possible geodetic technology and research up to the year 2000. The problems and expected development are placed in the context of surveying and measurement techniques in the German Democratic Republic. R.B.

N70-39832# Woods Hole Oceanographic Institution, Mass.
SERIAL ATLAS OF THE MARINE ENVIRONMENT. FOLIO 19: THE WATER MASSES OF THE NORTH ATLANTIC OCEAN, A VOLUMETRIC CENSUS OF TEMPERATURE AND SALINITY
W. R. Wright and L. V. Worthington 1970 63 p
(Contracts N00014-66-C-0241; Nonr-241-12)
(AD-708372; WHOI-Contrib-2418) Avail: NTIS CSCL 8/10

The temperature-salinity correlation, has proved a valuable means of classifying and tracing water masses in the oceans of the world. A volumetric census of ocean waters by intervals of temperature and salinity is given for the North Atlantic. Author (TAB)

N70-39840*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
PRIMARY ELECTRON INFLUX TO THE DAYSIDE AURORAL OVAL
R. A. Hoffman and F. W. Berko Sep. 1970 24 p refs Submitted for publication
(NASA-TM-X-65344; X-646-70-351) Avail: NTIS CSCL 04A

Data from the OGO-*D* auroral particles experiment were analyzed to determine properties of the higher latitude region of electron precipitation in the dayside hemisphere. From seven months of data a probability map of occurrence of this structured, low energy precipitation was compiled. The highest probabilities are concentrated predominantly betwen 4 and 14 hours magnetic local time, and from 75 deg to 82.5 deg invariant latitude. It is shown that there is excellent congruity of the high probabilities of occurrence and the high probability of occurrence of discrete auroral optical emissions, which define the auroral oval in these hours. The soft energy spectrums measured and the estimated total energy influx during a particular precipitation event are appropriate for producing the type of aurora observed. It is concluded that the structured, low energy electron precipitation is the primary energy source for the dayside auroral oval. Author

N70-39861# Agbabian-Jacobsen Associates, Los Angeles, Calif.
STUDY OF EARTHQUAKE INPUT MOTIONS FOR SEISMIC DESIGN
Stuart D. Werner Jun. 1970 192 p refs
(Contract AT(49-5)-3012)
(TID-25438; R-6914-925) Avail: NTIS

Procedures for determining seismic input for use in the analysis and design of nuclear power plants were investigated. The study consisted of three primary tasks: procedures for the

determination of site-dependent earthquake ground motions, a survey and assessment of existing soil/structure interaction analysis techniques, and a first-level approach to the representation of earthquake ground motions in a region. The results of each task are presented with recommendations for further studies.
Author (NSA)

N70-39890# Ohio State Univ., Columbus. Dept. of Geodetic Science.
METHODS FOR THE COMPUTATION OF GEOID UNDULATIONS FOR POTENTIAL COEFFICIENTS Interim Scientific Report
Richard H. Rapp Ohio State Univ. Res. Found. Apr. 1970 24 p refs
(Contract F19628-69-C-0127)
(AD-707836; AFCRL-70-0281; Rept-132; SR-5 Avail: NTIS CSCL 8/5

The undulations of the geoid may be computed from spherical harmonic potential coefficients of the earths gravitational field. The report examines three procedures that reflect various points of view on how this computation should be carried out. One method requires only the flattening of a reference ellipsoid to be defined while the other two methods require a complete definition of the parameters of the ellipsoid. It was found that the various methods gave essentially the same undulations, provided that correct parameters were chosen for the reference ellipsoid. A discussion is given on how these parameters are chosen and numerical results are reported using recent potential coefficient determinations.
Author (TAB)

N70-39946# Ohio State Univ., Columbus. Dept. of Geodetic Science.
DIRECT EVALUATION OF THE EARTH'S GRAVITY ANOMALY FIELD FROM ORBITAL ANALYSIS OF ARTIFICIAL EARTH SATELLITES
Gabriel F. T. Obenson Ohio State Univ. Res. Found. Mar. 1970 236 p refs
(Contract F19628-69-C-0127)
(AD-707828; AFCRL-70-0201; Rept-129; SR-3) Avail: NTIS CSCL 8/5

The equations of motion of an artificial earth satellite are derived in terms of gravity anomalies. In practice, an adjustment using these equations should give more correct values for the gravity anomalies. To check the adjustment equations derived, a set of 184 15 degree x 15 degree equal area mean gravity anomalies, together with the coordinates of some ground stations and Keplerian elements of certain satellites were assumed correct. Satellite orbits were generated, their positions being given by topocentric right ascension, declination, and range, assuming their motion to be affected only by the earths gravitational potential. Errors were introduced into the assumed correct elements, new orbits were generated, and an adjustment was done to recover the introduced errors. Two solutions to recover the input anomaly errors were done. Author (TAB)

N70-39998# Teledyne Materials Research Co., Waltham, Mass.
WAVE HEIGHT MEASUREMENT TESTS Final Report
J. W. Wheaton 25 Aug. 1969 46 p refs
(Contract DOT-CG-94299-A)
(AD-708174; E-1184) Avail: NTIS CSCL 8/3

Tests were conducted to compare the sea spectra obtained by two different wave buoy configurations with sea spectra obtained simultaneously by the NAVOCEANO Wave Profiler, an airborne radar device. This report presents the results of the reduction of data from the two wave buoys. Analysis of the data indicates good agreement on the first day of tests, but significant differences on the second day. The effect of low-frequency cut-off is explored, and general conclusions are presented based on the tests. The data reported here are intended to be compared with the results obtained by the Canadian National Research Council and by the U. S. Naval Oceanographic Office. Author (TAB)

N70-40042# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
INVESTIGATION OF LAYERED TROPOSPHERIC STRUCTURES USING FORWARD-SCATTER TECHNIQUES
Uve H. W. Lammers and Joseph A. Short, Jr. Jan. 1970 44 p refs *Its* AFCRL Environ. Res. Papers No. 311
(AD-707819; AFCRL-70-0073) Avail: NTIS CSCL 4/1

A high-resolution forward-scatter system can be effectively used to study the tropospheric refractive-index structure over extended volumes of space. This report is a theoretical analysis of the performance of scan experiments in which the common volume is systematically moved through space by swinging the narrowbeam transmitter and receiver antennas in azimuth and elevation. Experimental evidence points toward a layered composition of the tropospheric refractive index. Various models of single or multiple layers of turbulent refractive-index perturbations, including vertical-layer widths that are a fraction of the common volume lateral dimensions, are used to simulate tropospheric conditions and to compute the spatial response of a narrowbeam forward-scatter system. The rather complex forward-scatter geometry along the great circle path and at a horizontal distance from it is evaluated in enough detail to allow accurate determination of scatter signals. The effect of specular contributions is included to show how a reflection term typically superposes on the scatter signal when the refractive-index field is analyzed. Refractive-index structures are constantly being changed and new ones produced by such parameters as wind and turbulence. Hence, the information obtained from the high-resolution forward-scatter system also relates to these parameters. Author (TAB)

N70-40052# Pacific Missile Range, Point Mugu, Calif.
ROCKETSONDE TEMPERATURE ERRORS
B. R. Hixon and B. Bollermann 25 Jun. 1970 21 p refs
(AD-708679; PMR-TP-70-1) Avail: NTIS CSCL 4/2

Occasionally rocketsonde flights have yielded significantly warmer temperature profiles than the conjunctive radiosondes in the overlap altitude region of 25 to 30 kilometers. In addition, near-sinusoidal oscillations in the rocketsonde temperature data have been found for many of these soundings. An analysis of a series of flights, conducted at Point Mugu, California, has indicated that both of these phenomena are most likely due to solar radiation effects upon the thin-film thermistor mounts currently used with the rocketsondes. The results of this analysis indicate that both of these anomalies in the temperature data occur when the thermistor sensor is intimately connected--both mechanically and thermally--to the thin-film mounting structure. An additional cause of the warm bias appears to be instrument infrared radiation of the film mount. Simple and inexpensive modifications to the Datasonde film loop thermistor mount are proposed to eliminate this bias effect, and to eliminate the sinusoidal temperature oscillations. Author (TAB)

N70-40083# Air Force Cambridge Research Labs., Bedford, Mass.
RESPONSE OF THE TRANSITION REGION TO INFALLING MATERIAL ASSOCIATED WITH SOLAR FLARES
Y. Nakagawa and Charles L. Hyder Apr. 1970 14 p refs Presented at the Chromosphere-Corona Transition Reg., Boulder, Colo., 25-27 Sep. 1969 *Its* Environ. Res. Papers No. 320
(AD-707821; AFCRL-70-0273) Avail: NTIS CSCL 3/2

The work is part of a continuing study of the solar activity that has a pronounced effect on our environment. The response of the transition region to infalling material associated with solar flares (often caused by the disparitions brusques, sudden

disappearance of prominences) is considered and the possibility of examining the height and structure of the transition region from such a response is discussed. Author (TAB)

N70-40102# California Univ., La Jolla. Inst. of Geophysics and Planetary Physics.
LOW LEVEL EARTH MOTION Final Report, 1 May 1964–30 Sep. 1969
Richard A. Haubrich, George Backus, Barry Block, Freeman Gilbert, and Robert D. Moore 1 May 1970 63 p refs
(Contract AF 49(638)-1388; ARPA Order 292-69)
(AD-707857; AFOSR-70-1693TR) Avail: NTIS CSCL 8/11

Contents: Constructing P-velocity models to fit restricted sets of travel-time data; Inversion of inaccurate gross earth data; Tidal to seismic frequency investigations with a quartz; Accelerometer of new geometry; Earth normal modes from a 6.5 magnitude earthquake; Microseism measurements on the deep ocean bottom; Ocean microseism measurements with a neutral bouyancy free-floating midwater seismometer; Seismic noise between 2.5 and 200 cycles per hour; and Linearization and calibration of electrostatically fedback gravity meters. TAB

N70-40118# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
SHOCK EFFECTS ON FROZEN MATERIALS EXPLODING WIRE EXPERIMENTS
James L. Smith Jun. 1970 16 p refs
(AD-707924; CRREL-RR-287) Avail: NTIS CSCL 8/13

Hugoniot curves were generated from simultaneous measurements of shock and free-surface velocities, obtained from samples of frozen Fairbanks (Fox) silt, using the exploding wire technique. The abrupt change in slope of the (U sub s) - (U sub p) Hugoniot is indicative of a phase change. The shape of the P-V Hugoniot suggests that the transformation begins immediately but does not go to completion. This means that, although the pressure lies slightly above the Rayleigh line through the mixed phase region, the slope does not increase as rapidly as it would if the material had stayed in the initial phase. Author (TAB)

N70-40140# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SIGNAL PROCESSING RESULTS FOR CONTINENTAL APERTURE SEISMIC ARRAY
Jack Capon 15 May 1970 45 p refs
(Contract AF 19(628)-5167; ARPA Order 512)
(AD-707863; TN-1970-15; ESD-TR-70-149) Avail: NTIS CSCL 17/10

The processing of short-period P-wave data from a continental aperture seismic array is considered. The array consists of sites located at the Large Aperture Seismic Array (LASA) in eastern Montana and Long Range Seismic Measurement (LRSM) stations located in North America. In particular, the feasibility of recognizing the arrival of the pP phase, making use of P-pP differences in velocity across such a large array, is considered. In addition, the determination of the P-wave source structure of an event is considered by using the array to essentially steer many beams in the vicinity of the epicenter of the event. The capability of the array to perform these two functions is evaluated and discussed in detail. Author (TAB)

N70-40155*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OZONE MEASUREMENTS IN THE MESOSPHERE AND STRATOSPHERE DURING TWO SIGNIFICANT GEOPHYSICAL EVENTS
Ernest Hilsenrath Jul. 1970 13 p refs Submitted for publication
(NASA-TM-X-65332; X-851-70-341) Avail: NTIS CSCL 04A

Measurements of ozone were performed in the mesosphere and stratosphere by means of a chemiluminescent, self-pumping, parachute sonde. Two ozone flights were performed in the Arctic winter at Pt. Barrow, Alaska (71N), in January 1969, during a seasonal transition in the upper atmosphere. The change in the measured profiles was consistent with the model of a simple oxygen atmosphere in chemical equilibrium, if the supply of atomic oxygen is assumed to be constant. A diurnal measurement was performed in March 1970 at Wallops Island, Virginia. The ozone concentration measured below 30 km was in good agreement with data from simultaneously flown balloon sondes. The data were also in general agreement with contemporary moist-atmosphere models and other empirical data above these altitudes. The nighttime mixing ratio between 60 and 67 km was approximately twice that measured during the day. The altitude resolution of the experiment is about 1 km, the precision 10%, and the absolute accuracy approximately 20%. Author

N70-40165*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY HOURLY VALUES OF EQUATORIAL Dst FOR 1969
M. Sugiura and D. J. Poros Sep. 1970 16 p
(NASA-TM-X-65334; X-645-70-345) Avail: NTIS CSCL 03C

The hourly values presented are based on data from the Honolulu and San Juan observatories and should be regarded as preliminary. Author

N70-40171# Westinghouse Research Labs., San Diego, Calif. Ocean Research Labs.
AN INTERNATIONAL ATTEMPT TO UNDERSTAND WIND GENERATED OCEAN WAVES. PART 1: THE EXPERIMENT Progress Report
Timothy P. Barnett 15 Jan. 1970 30 p refs
(Contract N00014-68-C-0366)
(AD-708763; Rept-69-951-Ocean-R4) Avail: NTIS CSCL 8/3

A 2-year field study of the mechanisms of wind wave generation and dissipation has been conducted in the North Sea. The study is a multi-nation effort. The experimental techniques and layout are described. The quality and quantity of data collected were good in 1968 and excellent in 1969. The results derived from these data are not discussed. Author (TAB)

N70-40212# Air Force Cambridge Research Labs., Bedford, Mass.
STUDIES OF THE COASTAL MORPHOLOGY ON SURTSEY ISLAND
John O. Norrman Apr. 1970 25 p Transl. into ENGLISH from the Swedish
(AD-707484; AFCRL-70-0212; AFCRL-Trans-73) Avail: NTIS CSCL 8/7

Investigations on the shore and offshore morphology of the volcanic island of Surtsey off the southeastern coast of Iceland are reported. The volcanic activity that started as a submarine explosion in November 1963 ended in June 1967. A photogrammetric map of the island is in preparation. During the winter 1967/68 there was a rapid retreat of the lava cliff on the southern coast. The cliff is 10-15 m in height. The maximum retreat was 140 m and the average retreat about 75 m. The amount of lava removed by erosion is estimated at 2 million cubic meters. The shoals of former cinder-cone islands (Surtla, Syrtlingur, and Jolnir), contemporaneously built up, were found to have been abraded during the last winter. The plateaus of Jolnir and Surtla had been lowered several meters. The submarine slopes of Surtsey were investigated by SCUBA diving down to a maximum of 40 m in depth. The sandy material of the slopes of the northern point

is deposited at the frictional angle of repose. There is active avalanching on these slopes. On the slopes of the southern coast angular blocks dominate. Author (TAB)

N70-40217# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME 7, NO. 1 Quarterly Report, 1970
Anne L. Carrigan, ed. Jun. 1970 13 p refs *Its* Spec. Reports No. 98
(AD-708699; AFCRL-70-0356) Avail: NTIS CSCL 3/2

The Bulletin is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. The first four issues, which encompassed 1964 data, constitute Volume I. Volume II (numbers 1-4) contains quarterly data for 1965 with Volume III (1966), Volume IV (1967), Volume V (1968), and Volume VI (1969). Program descriptions for all data sections are updated annually or as required, and are presented in Number 1 of each volume. The following types of data are contained within each issue: magnetometer, cosmic ray, ELF noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for January, February, and March 1970. Author (TAB)

N70-40220# Army Natick Labs., Mass. Earth Sciences Lab.
WEATHER EXTREMES AROUND THE WORLD
Pauline Riordan Jan. 1970 49 p refs
(AD-707920; ES-53; USA-NLABS-TR-70-45-ES) Avail: NTIS CSCL 4/2

The report consists of a map of world and continental weather extremes and a map of North American weather extremes, with comments on the reliability of the records shown. Included are highest and lowest temperatures, largest temperature ranges, greatest and least amounts of precipitation for various durations, maximum precipitation variability, greatest thunderstorm frequency, highest and lowest atmospheric pressure, highest solar radiation, largest hailstones, greatest snowfall, highest wind speed, highest humidity, and most frequent occurrence of dense fog. Both the absolute extreme and the most extreme annual average are given for most of the elements. As far as possible, the records are taken from official sources, and all of them are documented. Conditions of site, instrumentation, observational procedure, and other factors pertinent to the reliability of extremes are discussed. Author (TAB)

N70-40222# Army Foreign Science and Technology Center, Washington, D.C.
MANUAL FOR USING AERIAL PHOTOGRAPHS IN SOIL MAPPING
A. P. Mershin 8 May 1970 52 p refs Transl. into ENGLISH from Metod. Rukovodstvo po Ispolz. Materialov Aerofotosemki pri Pochv. Kartirovanii (Moscow), 1964 p. 1-64
(AD-708787; FSTC-HT-23-732-68) Avail: NTIS CSCL 8/3

The translation discusses the use of aerial photography in the mapping of soils. Much attention is given to the methods of interpreting soils by aerial photographs and to the study of interpreting soils by their distinctive characteristics in various zones and provinces. Several authors give their views on the interpretation of different soil characteristics such as those of alkali, saline, chestnut, meadow-chestnut, forest-steppe zones, forest and tundra zones, and swamps. The authors also point out that the application of aeromethods in the practice of large-scale soil mapping in the Soviet Union and abroad indicates the use of materials from aerial survey increases considerably the accuracy of soil mapping, reduces the volume of the field work, cuts down its cost and increases the practical value of soil maps. Author (TAB)

N70-40294# Space Data Corp., Phoenix, Ariz.
DESIGN, DEVELOPMENT AND FLIGHT TESTS OF CHEMICAL RELEASE PAYLOADS FOR UPPER ATMOSPHERE RESEARCH Final Report, Jul. 1968 - Aug. 1969
Edward F. Allen, Jr., Ronald Balfour, and Philip E. Beaudoin Dec. 1969 159 p
(Contract F19628-69-C-0030)
(AD-708730; SDC-TM-382; AFCRL-70-0195) Avail: NTIS CSCL 4/1

The rocket borne chemical payload systems were designed, developed and flight tested to give controlled releases of gases, vaporized liquids, and solids. Payloads consisted of chemical tanks, chemicals, fluid controls with associated plumbing, event programmer and aerodynamic envelope. Barium/Copper Oxide, Diborane, Tri-methylaluminum, Tri-ethylaluminum, Water/40 Volume % Methanol, Propane and Oxygen were provided. Chemical handling techniques were developed and engineering field services were provided to assist with payload launches. Author (TAB)

N70-40308# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A METHOD FOR RELATING SATELLITE PHOTOGRAPHS TO LOCATIONS
M. Nazirov 6 Nov. 1969 11 p Transl. into ENGLISH from Meteorol. Gidrol. (USSR), no. 5, 1969 p 89-91
(Contract NOw-62-0804-c)
(AD-700355; APL-CLB-3-T-616) Avail: NTIS CSCL 8/5

The paper discusses a convenient graphical method for establishing the coordinates of the sub-satellite point at the instant a photograph is taken; these coordinates are needed in the operation of typing photographs to locations. Author (TAB)

N70-40310*# Geological Survey, Menlo Park, Calif.
POSSIBLE APPLICATION OF REMOTE-SENSING TECHNIQUES AND SATELLITE COMMUNICATIONS FOR EARTHQUAKE STUDIES
Robert E. Wallace and David B. Slemmons (Nevada Univ.) Jun. 1966 9 p Presented at 2d US/Japan Conf. on Res. Related to Earthquake Prediction, 8 Jun. 1966 *Its* Tech. Letter NASA-41
(NASA Order R-09-020-015)
(NASA-CR-76299) Avail: NTIS CSCL 08G

A variety of remote sensing techniques and instruments are under development and appraisal, including both passive and active types. They make use of energy ranging from radar and microwave wavelengths through the visible part of the spectrum to ultraviolet and X-ray. Some techniques depend upon spectral analysis of the radiant energy, some instruments produce imagery by scanning techniques, and a variety of special cameras produce more nearly conventional photography. Author

N70-40311*# Geological Survey, Denver, Colo.
GEOLOGIC EVALUATION: RADAR IMAGERY OF TWIN BUTTES AREA, ARIZONA TEST SITE 15
John R. Cooper May 1966 15 p *Its* Tech. Letter NASA-28
(NASA Order R-09-020-015)
(NASA-CR-76004) Avail: NTIS CSCL 08G

Outcrops of glass-rich igneous rock appear as conspicuous dark spots on the depolarized radar image but are obscure on the polarized image and on aerial photographs. Both types of radar imagery clearly outlined an ancient, previously unrecognized flood plain. Author

N70-40326# Shock Hydrodynamics, Inc., Sherman Oaks, Calif.
CRATERING AND SURFACE WAVES CAUSED BY DETONATION OF A SMALL EXPLOSIVE CHARGE IN

ALUMINUM
Martin Rosenblatt, James J. Piechocki, and Kenneth N. Kreyenhagen Apr. 1970 69 p refs
(Contract DASA01-68-C-0044)
(AD-708784; DASA-2495) Avail: NTIS CSCL 19/4

Using the two-dimensional Lagrangian shep Shock-Hydrodynamic- Elastic- Plastic numerical technique, a calculation was made of the response of an aluminum block to the detonation of a small spherical explosive charge buried just below the surface. From the calculation, three waves are identified which produce upward velocities at the surface. The first two are the dilatational wave and the slower shear wave, which originate from the initial interaction of the explosive detonation with the aluminum. The third wave arrives later, propagating at shear wave speed. It appears to have its origin in the rebound of the bottom of the crater. The calculation is compared with results of a companion experiment (performed by Gulf General Atomic) in which surface motions were measured at avrious radial stations. The same three-wave structure was observed, but the measured wave amplitudes and the final crater dimensions were smaller than the calculated values. These discrepancies may be due to uncertainties in the energy content and the detonation characteristics of the small charge. Author (TAB)

N70-40328# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH IN THE USSR IN 1969
Yu. I. Yefremov, ed. et al 3 Sep. 1970 200 p refs Transl. into ENGLISH of 13th Plenary Session of Comm. for Space Res., Leningrad Report 'Issledovaniya Verkhney Atmosfery i Kosmicheskogo Prostranstva v SSSR v 1969 godu' Moscow, Nauka Publishing House, 1970 p 1–146
(JPRS-51308) Avail: NTIS

The development of space research in the USSR in 1969 proceeded in the following directions: investigation of the moon, the planets, and the sun; investigation of the processes and phenomena taking place in space; study of the earth's atmosphere; medical and biological investigations; improvement of the methods of utilizing outer space; and the use of satellites for communication and weather services. Outstandingly successful were the flights of the automatic interplanetary stations Venera-5 and Venera-6. Author

N70-40331# Hawaii Inst. of Geophysics, Honolulu.
T-WAVE GENERATION MECHANISM Final Report
Rockne H. Johnson and Roger A. Norris Jan. 1970 63 p refs
(Contract Nonr-3748(01); ARPA Order 218-7)
(AD-708695; HIG-70-7) Avail: NTIS CSCL 8/11

The transformation of earthquake body waves to T waves is as efficient at deep slopes as at slopes which transect the sofar axis. Moreover, spectral studies of T phase signatures have shown no basis for distinguishing between the two cases. As simple downslope propagation is inadequate to explain the production of T waves at deep slopes, that process is relegated a minor role in favor of scattering from the sea floor as the dominant mechanism. A slope in the direction of propagation insures that once energy is scattered in that direction the probability of its being unfavorably rescattered upon successive approaches to the sea floor will be less. Scattering near the sea surface is detectable in the absence of bottom-scattered T waves. Such abyssally generated T waves display a distinctly higher frequency spectrum when originating in subarctic regions than when originating in lower latitudes. This difference is ascribed to downward ducting of higher frequency energy from the subarctic surface channel. Author (TAB)

N70-40382# Air Force Cambridge Research Labs., Bedford, Mass.
RAINFALL, SOIL MOISTURE AND TRAFFICABILITY IN THE VICINITY OF SAIGON
Iver A. Lund and Marvin P. Meyer May 1970 19 p refs *Its* Air Force Surv. in Geophys. No. 219
(AD-707823; AFCRL-70-0276) Avail: NTIS CSCL 8/13

Trafficability, the ability of a soil to permit the movement of vehicles, is a function of soil strength. Soil strength is related to soil moisture, which in turn is related to many other variables such as soil type, drainage and vegetation. For the preparation of an accurate estimate of the effect of climatology on soil strength conditions, a long-time record of soil moisture measurements is required. For most places in the world no such record exists. In this study, equations developed for estimating soil moisture in sandy silt of the type found in low terraces in the Saigon area are used, in conjunction with a 22-year record of daily rainfall observations, to generate a soil moisture record. From knowledge of soil moisture-strength relations, a soil strength record is generated. This record is used to estimate, for each day of the year, the probability that a given type of vehicle will be able to execute severe maneuvers over the soil without becoming immobilized. Author (TAB)

N70-40392# Oregon State Univ., Corvallis.
QUALITATIVE AND QUANTITATIVE CHARACTERIZATION OF POROSITY IN VOLCANIC ASH
William Herman Dosk (M.S. Thesis) Jun. 1969 90 p refs
(Contract AT(45-1)-2062; Grant NSF GA-1355)
(RLO-2062-7) Avail: NTIS

Soils developed on volcanic ash exhibit unique properties not commonly observed in soils formed on other geologic material. Low thermal conductivities, low volumetric heat capacities, slow transport phenomena, excess macro-drainage and development of unique suites of clay minerals are some properties thought to be directly related to the vesicular nature of the parent ash. To establish cause and effect relationships in these soils, the porous nature of the system is defined. For comparative purposes, ejecta from Mazama and Newberry ash was studied. Mercury intrusion methods were used to determine pore size distribution. A description of weathering effects and differences in the eruptive nature of the source is included. Author (NSA)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N70-39015# Weapons Research Establishment, Adelaide (Australia).
A COMPARATIVE THEORETICAL EVALUATION OF FIVE COMMONLY USED TYPES OF UNSTEADY HEAT FLUX SENSOR
D. J. Baines Jan. 1970 93 p refs
(WRE-HSA-27) Avail: NTIS

Five commonly used types of heat flux sensor are compared to establish ranges of applicability in terms of heat flux level, testing time, and required frequency response. The frequency ranges in which various data reduction techniques give accurate results are also delineated. The five sensors considered are, the thin film sensor or surface thermometer, the thick film sensor, the wall calorimeter or slug calorimeter, the gradient sensor, and the thin disk sensor Gardon foil gage, asymptotic calorimeter, or thermal window. It is concluded that, for all but very short test times, the best choice is either the gradient sensor or the thin disk sensor, both of which are available commercially in simple forms giving outputs proportional to temperature difference. It is shown that these sensors must be modified to measure a temperature as well as the temperature difference if accurate results are to be obtained

under all mounting conditions, and that their frequency response deteriorates as the heat sink becomes less perfect. Charts are given to assist the selection of a sensor to meet particular experimental conditions. Author

N70-39023# Aeronautical Research Labs., Melbourne (Australia).
PERFORMANCE AT TRANSONIC SPEEDS OF AN ATTITUDE SENSING HEAD USING SHORT PROTRUDING TUBES
D. A. Secomb Mar. 1970 34 p refs
(ARL/A-321) Avail: NTIS

The performance of an attitude sensing head using short protruding tubes was determined in a transonic wind tunnel for Mach numbers 0.5-1.1 and pitch angles up to 25 deg. The differential pressure coefficient sensitivity is 0.10-0.11 per deg, and the useful operating range of pitch angle is + or − 10 deg. At higher angles the sensitivity drops, because the leeward tube is then enveloped in a region of separated flow. No large effect of Reynolds number was found within the range covered. A comparison of the sensitivity with that of commonly used yawmeter configurations is included. For the head, the sensitivity is 30 per cent higher than that of a comparable head using flush pressure holes. The greater operating range, and lesser susceptibility to manufacturing error or damage in service for the flush hole head would be overriding advantages. Author

N70-39031# Aeronautical Research Labs., Melbourne (Australia).
PERFORMANCE OF AN 0.81 INCH DIAMETER HEMISPHERE-CYLINDER YAWMETER AT TRANSONIC SPEEDS AND VARYING REYNOLDS NUMBER
D. A. Secomb Feb. 1970 23 p refs
(ARL/A-320) Avail: NTIS

Wind tunnel measurements of the sensitivity of a hemisphere-cylinder yawmeter of 0.81 in. (2.06 cm.) diameter having pressure holes at the location of 45.0 deg. surface slope were made for Mach numbers from 0.5 to 1.3 angles of attack from −5 deg. to +15 deg. and for Reynolds numbers based on hemisphere diameter in the range 30 thousand to 300 thousand. At comparable Reynolds numbers the results agree with earlier measurements on a similar yawmeter of 0.156 in. (0.40 cm.) diameter. At Mach numbers of 0.8 or higher the sensitivity is independent of Reynolds number, but at lower Mach numbers the sensitivity increases with increase of Reynolds number through the test range. The increase at Mach number 0.5 is approximately 15 per cent. The results provide some evidence that the relatively large pressure holes (subtending 7.8 deg. at the hemisphere centre) indicate too high a pressure. However, the principal cause of the variation of sensitivity with Reynolds number appears to be a change of flow regime of the type well known to occur on spheres. Author

N70-39047# International Commission on Radiation Units and Measurements, Washington, D.C.
RADIATION DOSIMETRY: X-RAYS AND GAMMA RAYS WITH MAXIMUM PHOTON ENERGIES BETWEEN 0.6 AND 50 MeV
15 Sep. 1969 30 p refs
(ICRU-14) Avail: ICRU $2.50; SOD

Methods for standardization of absorbed dose of X and gamma rays from 0.6 and 50 MeV are described. Determination of absorbed dose by ionization methods, chemical methods, and calorimetric methods are discussed; and transfer of an absorbed dose calibration to another center is considered. NSA

N70-39050 Arizona Univ., Tucson.
EVALUATION OF IMAGE TUBES FOR USE IN DIRECT PHOTOGRAPHY OF ASTRONOMICAL SOURCES
Richard Hayden Cromwell (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-18333

A brief description is given of the various types of image tubes presently used in astronomical research, and a review is presented of the past applications of image tubes to direct astronomical photography. A detailed laboratory evaluation of the Carnegie image tube is summarized, and photographs at the telescope are presented to confirm and extend the results obtained in the laboratory. Primarily two characteristics of the Carnegie tube, an over-all mottled sensitivity pattern and a light-induced background, are found to be responsibe for the loss in limiting magnitude of a Carnegie tube record. The photography of astronomical sources through narrow-band interference filters was found to be a particularly promising application of the Carnegie image tube. Preliminary tests reported include the photography of supernova remnants, planetary nebulae, galaxies, and reflection nebulae. Dissert. Abstr.

N70-39055# Aeronautical Research Labs., Melbourne (Australia).
RELIABILITY OF THE ONE AND TWO-EXPOSURE X-RAY STRESS MEASUREMENT TECHNIQUES
G. A. Hawkes Mar. 1970 11 p refs
(ARL/MET-70) Avail: NTIS

Calculations of the stress values which could be obtained using one- and two-exposure methods were made by taking the appropriate measurements from a number of multi-exposure stress determinations which were made over recent years. It is shown that in the case of aluminium alloys, about 10% of the single exposure measurements differ by more than 5 tons sq in from the multi-exposure result; however, for specimens which have suffered unidirectional plastic deformation this figure increases to 70%. The results of the two-exposure determinations are considerably better, the corresponding figures being approximately 0.2 and 2.0%. Author

N70-39062# Los Alamos Scientific Lab., N. Mex.
INTRODUCTION TO RESTORATION AND ENHANCEMENT OF RADIOGRAPHIC IMAGES
B. R. Hunt, D. H. Janney, and R. K. Zeigler 9 Apr. 1970 28 p refs
(Contract W-7405-eng-36)
(LA-4305) Avail: NTIS

The elements of the theory of restoration and enhancement of radiographic images are presented. Some practical considerations and some of the experiences in image processing by the digital computer are discussed. NSA

N70-39063# International Chemical and Nuclear Corp., Irvine, Calif. Nuclear Science Div.
MOESSBAUER EFFECT SPECTROMETRY FOR ANALYSIS OF IRON COMPOUNDS
Hubert K. Chow, Robert F. Weise, and Paul Flinn Oct. 1969 131 p refs
(Contract AT(30-1)-4023)
(NSEC-4023-1) Avail: NTIS

The backscatter spectrometer system was used to conduct experiments designed to demonstrate the potential applications of the Mossbauer effect backscattering method to three areas important to the ferrous-metals industry; phase identification, the study of phase transformations, and quantitative analyses of matrix compositions or phase concentrations. The experimental results demonstrated specific examples for each category of application. A detailed study of retained austenite in a series of steel samples previously analyzed by X-ray diffraction analyses showed that the Mossbauer effect backscatter method provides precisions and sensitivities which, as a minimum, are equivalent to those achievable by X-ray measurements. In specific matrices, this method also

provides unique information for metallurgical parameters. Recommendations are made for design refinements in the detector and its shielding which would substantially improve the ultimate sensitivity achievable in such measurements and would provide an extremely attractive data acquisition time for a single measurement. NSA

N70-39064# California Univ., Livermore. Lawrence Radiation Lab.
EXTENDED RANGE HIGH-SPEED FRAMING CAMERA
B. Brixner, A. Johnson, and O. Niemi 20 May 1970 5 p refs Presented at the 9th Intern. Congr. on High-Speed Phot., Denver, 3–7 Aug. 1970 Sponsored by AEC
(UCRL-72250; CONF-700802-1) Avail: NTIS

A unified design to include framing rate, recording time, aperture ratio, interframe time, internal magnification, extended spectral range, and maximized resolution, was proposed. In addition, ease of manufacture and maintenance were considered during the design phase. NSA

N70-39111# Tokyo Univ. (Japan). Inst. for Nuclear Study.
AUTOMATIC ANALYSIS OF SPARK-CHAMBER PHOTOGRAPHS, 2
T. Kiyoshima and Taketora Yamagata Jan. 1970 91 p In JAPANESE and ENGLISH
(SJC-T-70-1) Avail: AEC Depository Libraries

An automatic scanning system for spark chamber films has been constructed and a program system for its operation and the subsequent analysis has been developed. The latter consists of MAGREC (automatic scanning), MAGCAL (spatial reconstruction and kinematical calculation), and SUMMARY (statistical processing). It was used for analyzing 150,000 pictures, with a success rate of 82%. It took 0.8 sec per event for MAGREC and 0.5 sec for MAGCAL. The precision of the measurment and the propagation of its error have been treated. Author (NSA)

N70-39197# Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires.
SQUARE ROOT COMPUTER
David Da Costa Vieira, Jean Bertrand, and Alain Tattegrain Feb. 1970 10 p In FRENCH
(CEA-N-1233) Avail: AEC Depository Libraries

The square root computer is used for a special measurement on a loop of nuclear reactor Cabri. It provides a 0 to 10 volts continuous voltage signal which is proportional to the square root of the 0 to 10 volts input continuous signal. The basic principle pertains to operations on logarithms. Author (NSA)

N70-39256# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
RADIOMETERS WITH PARAMETRIC AMPLIFIERS OF 1.6 AND 3.3 cm WAVELENGTHS FOR THE RT-22 RADIO-TELESCOPE
V. P. Bibinova [1969] 5 p refs Transl. into ENGLISH from Tr. Fiz. Inst., Akad. Nauk SSSR (Moscow), v. 47, 1969 p 149–152
(CSIRO-Trans-10098) Avail: AEC Depository Libraries

Parametric amplifiers with low noise level and a wideband intermediate frequency amplifier were used for increasing the radiometer sensitivity of the RT-22 telescope. The measured fluctuation sensitivities of the radiometers were 0.12 and 0.3 K at tau = 1 sec for lambda = 3.3 cm and 1.6 cm. The 3 cm radiometer is more reliable and its stability has been proven over prolonged operation. Venus radio emission data have been obtained on the 1.6 cm radiometer. NSA

N70-39295*# Scientific Translation Service, Santa Barbara, Calif.
EXPERIENCE OF UTILIZATION OF TRANSISTORS FOR TEMPERATURE MEASUREMENTS IN BORE-HOLES [OPYT PRIMENENIYA TRANZISTOROV DLYA IZMERENIYA TEMPERATURY V SKVAZHINAKH]
V. V. Gordiyenko et al Washington NASA Sep. 1970 4 p refs Transl. into ENGLISH from the publ. 'Fizicheskiye Svoystva Veshchestva Zemnoy Kory. Geofizicheskiy Sbornik, Vypusk 21' Kiev, Dumka Press, 1967 p 37–38
(Contract NASw-2035)
(NASA-TT-F-13275) Avail: NTIS CSCL 14B

Diagrams and technical specifications of a thermometer for measuring the temperature in bore-holes are given. A transistor is used as the temperature sensing element. Author

N70-39332# General Electric Co., Philadelphia, Pa.
RESEARCH ON AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS Semiannual Report, Jul.–Dec. 1969
Gerald C. Huth, Peter V. Hewka, and Vincent L. Gelezunas Jan. 1970 121 p refs
(Contract AT(30-1)-3246)
(NYO-3246-TA-6) Avail: NTIS

Special emphasis has been placed on the continued development of uses of contoured silicon avalanche diodes as solid state radiation detectors and in understanding resistivity striations in silicon to attain silicon of more uniform and higher gain. Large area radiation detectors, low energy electron detection, collaborations in nuclear medicine and biology, and 17 keV X-ray detection considerations are discussed. The applications of avalanche-type detectors in nuclear medicine for beta, gamma, and X-ray detection are discussed. Considerations concerning specific isotopes in nuclear medical applications are presented including soft X-ray emitters (Fe-55 and Ca-41), Pu-238 and Pu-239, C-14, soft beta emitters (Ca-45 and S-35), tritium, and high energy beta emitters (P-32, Kr-85, and Sr-90). NSA

N70-39365# California Univ., Berkeley. Lawrence Radiation Lab.
SAMPO: A FORTRAN 4 PROGRAM FOR COMPUTER ANALYSIS OF GAMMA SPECTRA FROM Ge(Li) DETECTORS, AND FOR OTHER SPECTRA WITH PEAKS
Jorma T. Routti 20 Oct. 1969 34 p refs
(Contract W-7405-eng-48)
(UCRL-19452) Avail: NTIS

SAMPO is a Fortran 4 program written to perform the data-reduction analysis described by J. T. Routti and S. G. Prussin in Photopeak Method for the Computer Analysis of Gamma-Ray Spectra from Semiconductor Detectors, Nuclear Instruments and Methods 72, 125-142 (1969). The code has also been used to analyze other spectra with peaks and continua. Program SAMPO can be used for an automatic off-line or an interactive on-line analysis. It includes algorithms for line-shape, energy, and efficiency calibrations, and peak-search and peak-fitting routines. Different options are available to make the code applicable to accurate nuclear spectroscopic work as well as to routine data reduction. The mathematical methods and their coding are briefly described. Instructions for using the program and for preparing input data are given and the optimal strategies for running the code are discussed. Author (NSA)

N70-39377*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ELECTRONIC STRAIN-LEVEL COUNTER FOR AIRCRAFT STRUCTURAL MEMBERS
Felix L. Pitts and J. Larry Spencer Washington Sep. 1970 19 p refs
(NASA-TN-D-5944; L-7190) Avail: NTIS CSLC 14B

The description and test results of an electronic strain level counter designed for obtaining structural strain data on in-flight aircraft are presented. The device counts the number of times the strain at a point in a structural member exceeds each of four preset levels. A dead band is provided at each level to prohibit the

counting of small strain variations around a given preset level. A resistance strain gage is used as the sensor; microelectronic and discrete solid state circuits are used for signal processing, and electromechanical counters are used for data storage. Author

N70-39384# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
A NEW MAGNETOGRAPH FOR THE SIMULTANEOUS MEASUREMENT OF THE LONGITUDINAL AND TRANSVERSE ZEEMAN EFFECT IN THE SOLAR SPECTRUM
G. Bureckner [1970] 40 p Transl. into ENGLISH from Z. Astrophys. (Heidelberg), v. 68, no. 1, 1968 p 48–84
(CSIRO-Trans-9340) Avail: AEC Depository Libraries

The necessary optical and electronic modifications of the standard Babcock magnetograph are explained. Unno's theory of a normal Zeeman triplet in the solar atmosphere was used to transform the measured polarization values into field strength H and field angle psi, (psi referred to the line of sight). The values of H and psi are ambiguous, if one integrates the Unno theory over an exit slit width comparable with the line width. In order to exclude these ambiguities a suitable method of reduction was developed. Two vector magnetograms of a quiet and an active spot group are given and their characteristic differences are discussed. The magnetic field distribution of the active group in which the large proton flare of July 7, 1966, happened is given in detail. The magnetograph also was used as a standard Babcock magnetograph to record weak longitudinal fields in different lines of the solar spectrum. One gets clearcut differences between photospheric and chromospheric field patterns. These differences are more important in active than in quiescent groups. Author NSA

N70-39412*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE APPLICATIONS SRT
In its Res. and Advanced Develop. 31 Aug. 1970 p 1–4 (See N70-39411 22-34)
Avail: NTIS CSCL 20F

It is demonstrated that spectra between 1.0 and 5.0 micrometer with a resolution of 0.5 cm/1 can be obtained with a small interference spectrometer. The instrument weight, volume, and power requirements are reduced to a point where it is practical to consider its use on remote sensing applications. Such applications might include ground-based atmospheric analysis for trace constituents and their concentrations, balloon or aircraft measurements of meteorological phenomena, or planetary observations from outside the Earth's atmosphere. The immediate objective is to modify a breadboard of such an instrument to permit on-site evaluation of its output and real-time recording of the interferograms, and to verify the feasibility of the proposed instrument concept by tests in various operating environments. Author

N70-39453# Naval Research Lab., Washington, D.C. Physical Chemistry Branch.
THE ENERGETICS OF ELECTRON IMPACT REACTIONS
F. E. Saalfeld *In its* Rept. of NRL Progr. Feb. 1970 p 1–7 refs (See N70-39452 22-34)
Avail: NTIS

The material presented demonstrates how the mass spectrometer can be employed as a microcalorimeter for the determination of such thermodynamic properties as heats of formation and bond energies of free radicals, and of reactive or unstable molecules. Author

N70-39525# Stanford Univ., Calif. Dept. of Computer Science.
CAMERA MODELS AND MACHINE PERCEPTION
Irwin Sobel May 1970 104 p refs
(Contract ARPA SD-183)
(AD-708084; AIM-121) Avail: NTIS CSCL 6/4

The report developes a parametric model for a computer-controlled moveable camera on a pan-tilt head. The model expresses the transform relating object space to image space as a function of the control variables of the camera. We constructed a calibration system for measuring the model parameters which has a demonstrated accuracy more than adequate for our present needs. We have also identified the major source of error in model measurement to be undesired image motion and have developed means of measuring and compensating for some of it and eliminating other parts of it. The system can measure systematic image distortions if they become the major accuracy limitation. It has been shown how to generalize the model to handle small systematic errors due to aspects of pan-tilt head geometry not presently accounted for. The report demonstrates the models application in stereo vision and have shown how it can be applied as a predictive device in locating objects of interest and centering them in an image. Author (TAB)

N70-39529*# Perkin-Elmer Corp., Norwalk, Conn.
ADVANCED FIGURE SENSOR
Robert Crane, Jr. Washington NASA Sep. 1970 86 p refs
(Contract NAS12-681)
(NASA-CR-1659) Avail: NTIS CSCL 20F

The purpose of the advanced figure sensor project was to investigate key elements in an optical figure sensor suitable for eventual use in a spaceborne active optics telescope. The specific objectives were to develop: 1) a solid state optical frequency shifter, 2) a technique for measuring a parabolic primary mirror, and 3) a concept for measuring the alignment of the secondary mirror. The basic figure sensor employs an interference phase measuring interferometer combined with electronic circuits for making measurements in real time. Author

N70-39570# National Bureau of Standards, Boulder, Colo.
NOISE STANDARDS, MEASUREMENTS, AND RECEIVER NOISE DEFINITIONS
C. K. S. Miller, W. C. Daywitt, and M. G. Arthur *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 157–169 refs (See N70-39551 22-09)
Avail: SOD $5.50

Basic formulas used in analyzing radiometers are presented. The switching radiometer, and its development and usage in the standards field are discussed. The development of hot and cold thermal noise sources, noise diodes, and gas-discharge noise generators are surveyed, and the basic definitions of receiver noise performance are presented and discussed. Author

N70-39573# National Bureau of Standards, Boulder, Colo.
MEASUREMENT OF EFFECTIVE TEMPERATURES OF MICROWAVE NOISE SOURCES
J. S. Wells, W. C. Daywitt, and C. K. S. Miller *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 183–194 refs (See N70-39551 22-09)
Avail: SOD $5.50

A system for calibrating microwave noise sources at three selected frequencies in the range 8.2 to 12.4 GHz is described. A discussion of the reference standard noise source, an error analysis of the standard source and the comparison system, and evidence of system performance are discussed. Results of measurements indicate that the excess noise ratio of a specific commercial argon-filled noise source is 15.6 db at 9.8 GHz. A calibration service is available for tube-in-mount noise sources at the three selected frequencies at 9.0, 9.8, and 11.2 GHz. Author

N70-39599# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
MILLIMETER WAVELENGTH RESONANT STRUCTURES

R. W. Zimmerer, M. V. Anderson, G. L. Strine, and Y. Beers *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 403–410 refs (See N70-39551 22-09)
Avail: SOD $5.50

The construction is described of millimeter wave Fabry-Perot resonators, using both planar and spherical reflectors. The equivalent circuits of planar reflectors and the method of obtaining efficient power transfer into the resonators are also discussed. Author

N70-39600# National Bureau of Standards, Boulder, Colo.
SPHERICAL MIRROR FABRI-PEROT RESONATORS
Robert W. Zimmerer *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 411–419 refs (See N70-39551 22-09)
Avail: SOD $5.50

An experimental investigation of the Fabry-Perot interfometer (FPS) using spherical mirrors is reported. The FPS was operated as a microwave resonant cavity at 60 to 70 Gc. Measurements were made of the loss and coupling as a function of mirror spacing. The electric field variation within the resonator was also measured. Other characteristics of the spherical Fabry-Perot resonator were observed and are discussed. A qualitative discussion of the behavior of a spheroidal cavity resonator is presented and its relation to the FPS and beam waveguide is demonstrated. Author

N70-39601# National Bureau of Standards, Boulder, Colo.
NEW WAVEMETER FOR MILLIMETER WAVELENGTHS
Robert W. Zimmerer *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 420–421 refs (See N70-39551 22-09)
Avail: SOD $5.50

A wavemeter of simple design is described. The principle of operation makes use of a new development in physical optics. The actual performance of the device was measured and compared with the theory. Author

N70-39619# Central Research Inst. for Physics, Budapest (Hungary).
CALCULATIONS CONCERNING THE CALIBRATION CHARACTERISTICS OF A WHOLE BODY COUNTER
A. Andrasi and Gy Koetel [1970] 20 p refs
(KFKI-70-7) Avail: AEC Depository Libraries

A mathematical model was used to evaluate the photopeak efficiency for a point source to establish the most suitable geometry and the optimum operational parameters for a NaI(Tl) whole-body counter. The three geometries studied were tilting chair, arc, and scanning bed arrangements. NSA

N70-39625# Naval Research Lab., Washington, D.C.
AIRBORNE RADIAC Progress Report, 1 Jul.–31 Dec. 1969
Charles W. Peters, Allen L. Snyder, and Odell Rhue Apr. 1970 22 p refs
(AD-707997; NRL-MR-2131) Avail: NTIS CSCL 18/4

The report discusses the design and development of a Flyable Breadboard and an NRL-Breadboard of the Airborne Radiac. The detector development for both Breadboards is complete and data convertors for both systems have been specified and ordered. Author (TAB)

N70-39657# Air Force Missile Development Center, Holloman AFB, N.Mex.
EFFECTS OF FILM READER ERRORS AND OF LENS DISTORTIONS ON TRAJECTORY DATA DERIVED FROM FIXED CAMERA OBSERVATIONS
Herbert R. Lotze Jun. 1970 83 p refs
(AD-707874; MDC-TR-70-25) Avail: NTIS CSCL 14/5

An attempt is made to isolate errors caused by the film reader system and propagating into the target position derived from observations of fixed cameras which are arranged along a supersonic track. Errors of a size similar to the estimated error are identified for irregular shaped moving targets ejected from sleds if and only if observed by 2 cameras forming an acute angle between their lines of sight. Lens distortion effects are computed and evaluated for nine ribbon frame continuous motion cameras and for one 70mm, intermittent motion camera using L. N. Danners and D. C. Browns methods. Author (TAB)

N70-39745# Sandia Corp., Albuquerque, N.Mex.
EFFECT OF MISALIGNMENT BETWEEN VEHICLE GEOMETRIC AXIS AND SPIN AXIS UPON ROLL-MODULATED ATMOSPHERIC DENSITY MEASUREMENTS
Robert O. Woods Apr. 1970 16 p refs
(SC-RR-70-257) Avail: NTIS

A commonly used method of reducing the data from vacuum gauges mounted in a spinning vehicle is implicity dependent upon the assumption that the spin axis of the vehicle coincides with its geometric axis. The effects of errors in this alignment are investigated, and it is shown that, depending upon the orientation of the gauge with respect to the axes, the effect can be to cause either an apparent increase or decrease in ambient density. The magnitude of the error is dependent upon vehicle velocity and the molecular speed of the atmosphere. Curves are plotted showing the range in errors obtained under conditions typical of a sounding rocket experiment. A method of performing the error calculations in specific cases is described, and tables are given to facilitate the computations. Author

N70-39760# Technical Univ. of Denmark, Lyngby.
AN AUTOMATIC-RECORDING CONSTANT-VELOCITY MOESSBAUER SPECTROMETER [ET AUTOMATISK KONSTANT HASTIGHEDS MOESSBAUER-SPEKTROMETER]
Niels Thrane Oct. 1969 61 p refs In DANISH; ENGLISH summary
(NP-18189) Avail: AEC Depository Libraries

The construction and performance of an automatic-recording constant-velocity Moessbauer spectrometer primarily for studying Fe-57 and Sn-119 is described. The spectrometer is suitable for examination of individual absorption lines in a Moessbauer spectrum. The spectrometer covers the velocity range from −10 mm/sec to +10 mm/sec with a velocity stability and resolution less than 0.01 mm/sec at low velocities. The instrument has been used for measurements on solid solutions of Sn and Sb in Fe. Author (NSA)

N70-39769*# Scientific Translation Service, Santa Barbara, Calif.
A TECHNIQUE FOR STUDYING LONGITUDINAL WAVE VELOCITY AT HIGH PRESSURES USING AN ACOUSTICAL DELAY LINE [METODIKA IZUCHENIYA SKOROSTI (VPM) PRI VYSOKIKH DAVLENIYAKH S ISPOLZOVANIYEM A KUSTICHESKOY LINII ZADERZHKI]
D. V. Korniyats Washington NASA Sep. 1970 12 p refs Transl. into ENGLISH from Geofizicheskiy SB., Inst. Geofiziki Akad. Nauk (Kiev), no. 24, 1968 p 32–38
(Contract NASw-2035)
(NASA-TT-F-13273) Avail: NTIS

The tested method of velocity measurements using a time delay line makes it possible to carry out investigations at high pressures with a relative root mean square error = 0.5%. The elaborated design of the time delay line with transformer oil as an acoustic medium is simple, reliable, and convenient, making it also possible to space the sensors with a high enough precision. A piezoelectric sensor with a thin diaphragm enables various piezoelements in form of plates with electroconductive coating to be used for ultrasonic studies. Author

N70-39773*# Little (Arthur D.), Inc., Cambrige, Mass.
INTERMEDIATE ACCURACY INTEGRATING GYROSCOPES: DESIGN CRITERIA MONOGRAPH
Robert. G. Haagens Jun. 1970 97 p refs
(Contract NAS12-2077)
(NASA-CR-113572) Avail NTIS CSCL 17G

The state of the art of single degree of freedon floated gyroscopes is considered. Emphasis is placed on failures and performance degradation in the classical areas: (1) the gyro wheel package, ball bearing as well as gas bearing; (2) case to float considerations, including hermetic seals and flotation/damping fluids; (3) restraint drift torques. Author

N70-39820# Central Research Inst. for Physics, Budapest (Hungary).
CALCULATION CONCERNING THE CALIBRATION OF A WHOLE BODY COUNTER
A. Andrasi, I. Feher, and Gy. Koetel [1970] 17 p refs
(KFKI-70-4) Avail: AEC Depository Libraries

Calculations of the relative photopeak efficiencies of NaI(Tl) scintillation detectors using the tilting chair and scanning geometries with point sources are described. Measurements with a cesium-137 point source were performed and compared to the calculated results. NSA

N70-39892# Naval Research Lab., Washington, D.C.
POTENTIAL AND LIMITATIONS OF SEVERAL NEUTRON COINCIDENCE EQUIPMENTS Interim Report
Charles V. Strain May 1970 49 p refs
(AD-707706; NRL-MR-2127) Avail: NTIS CSCL 18/4

Coincident neutron detectors which can distinguish between neutrons occurring as a result of fission and those due to (alpha, n) or (Gamma, n) nuclear reactions have been described in a preceding report. The report discusses several methods of developing follow-on equipments with greater potential for the nondestructive assay of plutonium samples. The effect on equipment performance of the efficiency and neutron lifetime in the neutron detector and of analysis gate length and equipment dead times are treated in considerable detail and several illustrative examples are presented. Performance is generally improved by an increase of neutron efficiency accompanied by a decrease in neutron lifetime and the use of optimized analysis circuitry. Good performance can be obtained with complex 4 pi moderating detectors which employ an array of enriched BF3 or 3He neutrons detection tubes dispersed in a hydrogeneous moderator. TAB

N70-39898* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INSTRUMENT SUPPORT WITH PRECISE LATERAL ADJUSTMENT Patent
Wilhelm Angele and Donelson B. Horton, inventors (to NASA) Issued 18 Dec. 1962 (Filed 12 Oct. 1961) 6 p Cl. 248-346
(NASA-Case-XMF-00480; US-Patent-3,069,123; US-Patent-Appl-SN-144804) Avail: US Patent Office CSCL 14B

A fine adjustment device which is rugged, simple of operation, and easy to operate and maintain, is described for incorporation with a roundness measuring apparatus. The adjustment is made solely through the elasticity of the beams or deflection imparting means. The fineness of the adjustment is dependent on the lever arm ratio of the beams and their elasticities and the screw pitches of the deflection inducing means. N.E.N.

N70-39900*# Lockheed Electronics Co., Houston, Tex.
PHOTOGRAPHIC CAMERA SYSTEM Patent Application
Leonard Richard Lankes, inventor (to NASA) Filed 8 Jul. 1970 21 p Sponsored by NASA
(NASA-Case-MSC-13322-1; US-Patent-Appl-SN-53155) Avail: NTIS CSCL 14E

A camera system with the light sensing and light recording functions physically separated is described. The light sensing function is provided by forming an image of the scene to be photographed, moving the image past an aperture having a diameter in the range of a few microns, and sensing the light passing through such aperture by means of a photomultiplier tube. In one arrangement, the light recording function is provided by scanning a photographic emulsion with a polarized laser beam having a spot diameter of less than three microns. The intensity of the beam is modulated by supplying the electrical signals developed by the photomultiplier tube to an electrically-controllable polarizer located in the beam path. In a second arrangement, the light recording function is provided by scanning a photographic emulsion with an electron beam having a spot diameter of one micron or less. The intensity of this beam is modulated by the electrical signals developed by the photomultiplier tube. The photomultiplier tube has a high sensitivity homogeneous photocathode and the photographic emulsion is of the high resolution ultrafine grain or grainless type. NASA

N70-39913# Rome Air Development Center, Griffiss AFB, N.Y.
ELECTRO-OPTICAL IMAGE ENHANCEMENT EVALUATION Technical Report, Jan. – Sep. 1969
Thomas L. Coluccio and James E. Wasielewski May 1970 37 p ref
(AD-708156; RADC-TR-70-35) Avail: NTIS CSCL 14/5

The objective of the study was to evaluate the extent to which an existing electro-optical technique could improve the performance of image interpreters identifying tactical targets from degraded imagery. The interpreter performance of eight subjects using the Image Enhancing Microscope was compared to their performance utilizing conventional image interpretation techniques. Both accuracy and completeness scores were considered. The test imagery consisted of Minuteman missile sites in various stages of construction which was degraded in resolution and contrast. Evaluation of the enhancement technique yielded significantly inferior performance in comparison with conventional techniques. Author (TAB)

N70-39935# Naval Postgraduate School, Monterey, Calif.
APPLICATION OF HOLOGRAPHIC INTERFEROMETRY TO ANALYSIS OF SINUSOIDALLY EXCITED ACOUSTIC TRANSDUCERS
David John Griffiths (M.S. Thesis) Dec. 1969 52 p refs
(AD-708391) Avail: NTIS CSCL 20/5

An application of optical holography known as Holographic Interferometry has been developed which enables experimentalists either to measure deformations of a few microns in loaded mechanical systems or to examine relative displacements in sinusoidally-vibrating systems. The fundamental theory of holography and four techniques for holographic interferometry are described in this report. A system constructed to record interferograms of acoustic transducers operating either in air or submerged in water is discussed and some results of examining a sinusoidally-excited 7-inch permanent-magnet loudspeaker with interferograms are considered. Author (TAB)

N70-39991# White Sands Missile Range, N.Mex. National Range Engineering.
GROUND OPTICAL RECORDER FOR INTERCEPT DETERMINATION (GORID), MK-1A Final Report
Kenneth B. Bellinger May 1970 33 refs
(AD-707933; STEWS-RE-1-70-1) Avail: NTIS CSCL 17/8

The Ground Optical Recorder for Intercept Determination (GORID), MK-1A, is a development model of a tracking telescope with increased capability to provide optical attitude, event, and miss-distance as compared to tracking telescopes currently in service at WSMR. Through the choice of three long focal lengths (90,

180, and 360 inches), coupled with a precise tracking mount of considerable dynamic range, the GORID offers a very versatile instrument applicable to a variety of optical recording tasks. Through the use of high resolution retro-fitted shaft-angle encoding equipment, it also could provide space position at altitudes exceeding 100,000 feet. Author (TAB)

N70-40003* Rochester Univ., N.Y.
CONCAVE GRATING SPECTROMETER Patent
M. V. R. K. Murty, inventor (to NASA) Issued 18 Jan. 1966 (Filed 28 Sep. 1962) 6 p Cl. 88-14 Sponsored by NASA
(NASA-Case-XGS-01036; US-Patent-3,229,568; US-Patent-Appl-SN-227692) Avail: US Patent Office CSCL 20F

A concave grating spectrometer, capable of use in near and vacuum ultraviolet regions, is described, in which the scanning arrangement is such that movement of the concave grating is eliminated and the Rowland circle associated with it is fixed. A mirror is provided normal to the plane of the Rowland circle, and the radiation source or entrance slit is placed near the center of curvature of the concave grating on the circumference of the circle. The mirror intercepts the diffracted beams from the concave grating, and the spectrum is formed on the circle near the grating. A viewing means, or exit slit, is located at this point on the circle where the spectrum is located. The mirror is driven by a sine-bar mechanism so that it rotates about a pivot point at the center of the Rowland circle and the spectrum on the circle is moved; in this way, no defocusing occurs. P.A.B.

N70-40006# Army Foreign Science and Technology Center, Washington, D.C.
CONVERSION OF SIGNALS FROM A RESTRAINED ANEMOMETER
V. Yu. Torochkov 17 Apr. 1970 8 p Transl. into ENGLISH from Nauchn. Issled. Inst. Gidrometeorologicheskogo Priborostr. Tr. (USSR), n. 17, 1967 11–13
(AD-707683; FSTC-HT-23-973-70) Avail: NTIS CSCL 4/2

The paper considers one of the possible circuits by which the torsion oscillations of a restrained anemometer can be converted to an electrical signal and subsequently damped. Author (TAB)

N70-40017* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SELF-STABILIZED THEODOLITE FOR MANUAL TRACKING USING PHOTOSENSITIVE STABILIZING MEANS Patent
George Allan Smith, inventor (to NASA) Issued 18 Jan. 1966 (Filed 30 Mar. 1962) 9 p Cl. 250-203
(NASA-Case-XAC-00460; US-Patent-3,230,377; US-Patent-Appl-SN-183979) Avail: US Patent Office CSCL 17H

A device is described for determining the angular orientation of the line of sight between a target and an inertial reference system on a manned space vehicle. A vernier theodolite and a pair of star trackers in predetermined fixed orientation are mounted on a stabilized platform. The star trackers produce error signals which are used to control and operate a mechanism for stabilizing the platform according to deviations of the line of sight of the star trackers from direct alignment with predetermined reference stars. The platform is maintained in a precise position relative to inertial space and the target angle readings from the theodolite are used in navigating the spacecraft. R.B.

N70-40019*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
DISPLAY SYSTEM Patent Application
Anne W. Story, inventor (to NASA) Filed 16 Jul. 1970 21 p
(NASA-Case-ERC-10350; US-Patent-Appl-SN-55535) Avail: NTIS CSLC 09E

A situational display and a means for creating the display are disclosed. The display comprises a moving line or raster, on a cathode ray tube, which is disposed intermediate of two columns of lamps or intensifications on the cathode ray tube, the raster and lights to either side thereof being controlled in such a manner that pairs of lights define a line which is either tracked or chased by the raster in accordance with the relationship between the optimum and actual values of a monitored parameter. NASA

N70-40028# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
PORTABLE INSTRUMENT PACKAGE (PORTAPAK) FOR THE MEASUREMENT OF NOISE AND VIBRATION
Harold K. Hille, J. F. Rose, Jr., and L. Keith Kettler (Dayton Univ. Res. Inst.) Mar. 1970 27 p
(AD-707826; AMRL-TR-69-75) Avail: NTIS CSCL 14/3

A portable, self-contained, instrument package (PORTAPAK) for recording noise and vibration environmental data in and around aircraft was developed. It was especially designed for use in field surveys where conditions limit the use of large and heavier recording equipment. The battery-operated recording system consists of a tape recorder and associated circuitry, a condenser microphone and a linear servo accelerometer as the vibration transducer. It weighs only 30 pounds and the overall dimensions are 17 inches wide, 14 1/2 inches deep and 5 1/2 inches high. Noise levels from 54 to 150 db SPL in the frequency range from 20 to 16,000 Hz and acceleration levels from 0.3 to 5 G in the frequency range from dc to 30 Hz can be measured. A complete description of the system is included and its performance characteristics for both the acoustical and vibration recording section are given. Author (TAB)

N70-40039# Lowell Technological Inst. Research Foundation, Mass.
DESIGN, CONSTRUCT, TEST AND CALIBRATE DENSITY MEASUREMENT, ROCKET PAYLOADS UTILIZING THE BREMSSTRAHLUNG EFFECT Final Report, 1 May 1967–30 Nov. 1969
Kirtland H. Olson Feb. 1970 133 p refs
(Contract F19628-67-C-0278)
(AD-708183; LTIRF-304/TA; AFCRL-70-0148) Avail: NTIS CSCL 9/1

This report summarizes the design and construction of two NIRO payloads to measure upper atmospheric density between 100 and 200 km. Schematic diagrams and parts identification describe the 5 kV, 1 mA electron gun control circuits as well as 2 to 5 keV X-ray detectors and integrated circuit scalers. Problem areas discussed include: charge buildup, opening electron guns, X-ray detector properties, and weight constraints. Component failures during testing resulted in adding components to protect against high-voltage arcing. Detailed estimates of system error indicated that improved electronics could reduce errors to 10%. Author (TAB)

N70-40070*# Bendix Corp., Detroit, Mich. Launch Support Div.
COLOR PERCEPTION TESTER Patent Application
Robert B. Martin, Eddie L. Brawner, and Wayne E. Pate, inventors (to NASA) Filed 9 Sep. 1969 9 p Sponsored by NASA
(NASA-Case-KSC-10278; US-Patent-Appl-SN-856327) Avail: NTIS CSCL 06D

A color perception tester for testing individuals in order to determine if the individual can correctly identify wires in accordance with their respective color code is described. The tester includes colored wires which, when plugged in the appropriate receptacle or plug, will cause a pair of adjacent lamps to be illuminated. Indicia are printed adjacent the plug identifying the proper colored wire which should be plugged in the circuit. NSA

N70-40073# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
A NEW FERROELECTRIC TRANSDUCER FOR USE IN HEAT

TRANSFER AND FLOW STUDIES
Kenneth R. Jolls and Pasquale M. Sforza 1970 9 p refs
(Contract Nonr-839(38); ARPA Order 529)
(AD-707738) Avail: NTIS CSCL 14/2

A transducer is described for the measurement of heat transfer rates in gaseous systems. Based on the ferroelectric properties of tri-glycine sulphate(CH2NH2COOH)3. H2SO4, the device autostabilizes its operating temperature so that external heat-transfer depends linearly upon the ambient temperature and the film coefficient. An analysis of temperature stability in several heat-sensitive transducers is presented, and the fundamental improvement in stability offered by the ferroelectric probe is demonstrated both in the analysis and experimentally. Data are presented in reference to possible applications of the device as a linear heat-transfer gauge and a binary gas analyzer. A qualitative discussion of transient response is given, and a comparison is made to a similar technique for the linear detection of diffusion-controlled processes in convected mass-transfer systems. Author (TAB)

N70-40086# Air Force Cambridge Research Labs., Bedford, Mass.
REMOTE SENSING: SPECIAL REPORTS
Harald Svensson May 1970 23 p Transl. into ENGLISH from Forskning Och Framsteg (Sweden), no. 5, 1969 p 10–19
(AD-707824; AFCRL-70-0277; AFCRL-Trans-79) Avail: NTIS CSCL 14/5

The parts of the electromagnetic spectrum are discussed, with the type(s) of sensor(s) required to record energy in each part. A review is given of the classes of airborne (and satellite) remote sensor data which are available to geoscientists. Different types of remote sensor data are described and examples provided, including panchromatic, infrared, color, and color infrared aerial photography (Kullaberg, Sweden); multispectral aerial photography (with importance of optimum film/filter combination for specific phenomena); airborne thermal infrared imagery (Kullaberg, Sweden and Surtsey, Iceland); side-looking airborne radar (Tuskahoma Syncline, Oklahoma); and radio sounding of glacial ice (Antarctica). The projected future increase in amount of remote sensor data will require computer processing techniques, although man will serve the most important role in the analysis and use of remote sensor information of the earths surface. Author (TAB)

N70-40101# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Wave Superheater Dept.
HIGH SPEED MINIATURE ENTHALPY PROBE DEVELOPMENT Final Report, Sep. 1968–Jan. 1970
F. A. Vassallo Feb. 1970 76 p refs
(Contract F33615-69-C-1037)
(AD-707859; ARL-70-0018) Avail: NTIS CSCL 14/2

A study is reported in which very fast acting miniature enthalpy probe systems are evaluated. Probe operation is based on the total calorimetric principle whereby a heat balance on a gas sample is obtained in a very few milliseconds. Uncooled probe systems are investigated from the standpoint of applicability to the wall stabilized arc located at the Thermomechanics Laboratory of ARL. Enthalpy probe development is discussed and the resulting probe models are described in detail. Comparative evaluations using other enthalpy measuring techniques are reported as well as studies of single sweep enthalpy profile determinations. Probe operational limits are indicated through results of tests at enthalpies above 4500 Btu/lb. Author (TAB)

N70-40106# Texas Univ., Austin. Electronics Research Center.
THE FEASIBILITY OF A RADIATION DETECTION SCHEME UTILIZING THE PYROMAGNETIC EFFECT Interim Scientific Report
Roy E. Caruthers and Rodger M. Walser 4 May 1970 90 p refs
(Grant AF-AFOSR-766-67)
(AD-707835; AFOSR-70-1669TR; TM-18) Avail: NTIS CSCL 20/3

A study has been made of the feasibility of using the pyromagnetic effect for detecting electromagnetic radiation. In the pyromagnetic detector, a voltage is induced in a coil surrounding a magnetic material when that material is subjected to a heat pulse. This voltage, which is the exact dual of the induced current in a capacitor due to the well known pyroelectric effect, is generated by the time varying magnetization component that results from the thermal perturbations. The pyromagnetic response of both first and second order transition materials was investigated as the material was warmed through the transition region. The very first measurements with gadolinium confirmed the intended goal of this feasibility study and the research effort concentrated on several aspects related to optimization. Typical sensitivities were on the order of 0.1 microvolt/watt/coil turn but the NEP was always limited by stray pickup. These measurements were performed with common phase detection techniques with beam chopping rates from 10 to 1000 Hz. In view of these initial measurements, it is felt that a detector using the pyromagnetic effect has promise as a fast, sensitive, room temperature detector for the range of frequencies from microwave to optical. Author (TAB)

N70-40157* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRCRAFT INSTRUMENT Patent
Joseph W. Wetmore, inventor (to NASA) Issued 7 Dec. 1965 (Filed 9 Nov. 1962) 15 p Cl. 73-178
(NASA-Case-XLA-00487; US-Patent-3,221,549; US-Patent-Appl-SN-236748) Avail: US Patent Office CSCL 01D

An aircraft instrument is described which permits pilot control of aircraft rotation in takeoff attitude at the proper speed, near optimum climbout path control, and vertical plane flight path control in poor visibility conditions. The instrument combines angle-of-attack indications for controlling takeoff rotation with total-pressure rate of change indications and eliminates low-frequency, poorly damped, large amplitude, phugoid oscillation of the flight path. The instrument is composed of pneumatic and mechanical components with an electrical servomotor drive for positioning an angle-of-attack sensing head, and self-synchronizing motors for indicating the angle-of-attack head position. The linkage system, operation, instrument adjustment, modifications, mathematical models, and figures are presented. J.M.

N70-40161# Army Behavior and Systems Research Lab., Arlington, Va.
UNAIDED READING OF CODED RECONNAISSANCE DATA
Thomas E. Jeffrey Dec. 1969 40 p
(AD-707377; BESRL-TRN-220) Avail: NTIS CSCL 5/9

The general objective of the research study was to determine the feasibility of having image interpreters decode sensor and terrain information encoded on imagery by direct viewing instead of resorting to use of elaborate code reading machines. In the experiment, achievement was measured in terms of time required for interpreters to locate the required code matrix block, decode and record the data, and number of correct decodings. Author (TAB)

N70-40201* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPARATUS FOR ABSORBING AND MEASURING POWER Patent
Robert Y. Wong, William J. Nusbaum, and Donald E. Holeski, inventors (to NASA) Issued 7 Dec. 1965 (Filed 16 Aug. 1963) 7 p Cl. 73-134
(NASA-Case-XLE-00720; US-Patent-3,221,547; US-Patent-Appl-SN-302749) Avail: US Patent Office CSCL 14B

An air brake device for determining the amount of power dissipated in the bearings and seals around a rotating shaft is

described. The reverse turbine air brake absorbs and measures torque from a shaft. An air inlet manifold is connected to a supply of braking fluid such as compressed air. The fluid is discharged from the manifold and enters an inlet collector which directs the braking fluid parallel to the axis of rotation of the shaft. The fluid is accelerated through the stator blades and given a tangential momentum in the opposite direction to the rotation of the rotor. The braking fluid then passes across the rotor blades and the rotor removes its tangential momentum thereby absorbing power from the shaft. N.E.N.

N70-40203* Hughes Aircraft Co., Culver City, Calif.
THRUST DYNAMOMETER Patent
Siegfried Hansen, inventor (to NASA) Issued 24 Aug. 1965 (Filed 15 Feb. 1963) 4 p Cl. 73-116 Sponsored by NASA
(NASA-Case-XLE-00702; US-Patent-3,201,980;
US-Patent-Appl-SN-258931) Avail: US Patent Office CSCL 14B

The dynamometer described is designed to measure the microforce thrust produced by an ion reaction engine. A substantially level, horizontally movable rectangular platform is supported by a plurality of elongated leaf springs. Mounted on the upper surface of the platform is an ion engine which develops thrust forces in the order of 10 to 1000 micropounds. The platform tends to move horizontally under the influence of any added force such as that produced by the thrust of the ion engine. A servo feedback system, including a movable coil permanent magnet as a motor to develop a counterthrust equal and opposite to that of the engine and also including an electromagnetic sensor, is provided. Any movement of the platform is detected by the sensor, which relays a signal to the movable coil unattached to but influenced by the magnet. The coil then produces the counterthrust to counteract the movement of the platform. This counterthrust is measured by a dc meter so as to determine the engine thrust. It is stated that the sensor is capable of detecting a platform deflection created by ion engine thrust of about one micropound. P.A.B.

N70-40233* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MEASURING DEVICE Patent
Joseph C. Doyle, Frank A. Burgett, Dale George Sauers, and Robert M. Bernardin, inventors (to NASA) Issued 11 Jan. 1966 (Filed 30 Jul. 1964) 8 p Cl. 222-45
(NASA-Case-XMS-01546; US-Patent-3,228,558;
US-Patent-Appl-SN-386467) Avail: US Patent Office CSCL 09E

An expulsion and measuring device is described in which the quantity of liquid in a tank may be immediately determined when the tank is in a zero gravity environment. An impervious elastic bladder or diaphragm is located within the tank to separate it into two airtight sections. The usable liquid is stored on one side of the bladder and the space on the other side is pressurized with a gas. In order to expel the liquid from the tank, the gas pressure on the bladder is gradually increased to expand the bladder against the liquid, which forces the liquid through an outlet in the end of the tank. The amount of fluid remaining in the tank which senses the movement of the bladder is determined by an electromechanical transducer along the tank. R.B.

N70-40238* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRO-OPTICAL ALIGNMENT CONTROL SYSTEM Patent
Robert J. Schwinghamer and John R. Rasquin, inventors (to NASA) Issued 11 Jan. 1966 (Filed 29 Nov. 1962) 9 p Cl. 250-201
(NASA-Case-XMF-00908; US-Patent-3,229,089;
US-Patent-Appl-SN-241085) Avail: US Patent Office CSCL 09E

An alignment system is described for maintaining two-axis alignment between objects, in which one of the objects maintains a reference position in a plane lying in one of two axes which is perpendicular to the other axis. One of the movable bodies contains a small area source of radiant energy and the other contains an element for sensing the energy. Circuits are provided which respond to directional misalignment between the energy source and sensor. The circuits provide a first electrical output representative of misalignment in the referenced plane and a second electrical output representative of misalignment along the referenced perpendicular line. The device is suitable for moving milling tools along the circumference of a large diameter tank-section during milling operations on extremely large vehicles. R.B.

N70-40239* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RADIATION DIRECTION DETECTOR INCLUDING MEANS FOR COMPENSATING FOR PHOTOCELL AGING Patent
Paul R. Spencer, Seymour Salmirs, and Ernst F. Germann, Jr., inventors (to NASA) Issued 11 Jan. 1966 (Filed 31 May 1962) 8 p Cl. 250-203
(NASA-Case-XLA-00183; US-Patent-3,229,102;
US-Patent-Appl-SN-199202) Avail: US Patent Office CSCL 18D

A solar sensor is described which provides an electrical signal that is proportional to the angle of incidence between the solar disk and a reference axis on the sensor. A group of planar photocells is positioned on and inclined at large, equal angles to a flat base and is arranged at equal angles about a reference axis extending perpendicular to the sensor base. The particular arrangement of the photocells eliminates the effects of reflected solar radiation from nearby planetary bodies. A drift compensator is also provided to correct errors that may occur after prolonged operation of the sensor due to asymmetrical aging of the sensor transducer elements. R.B.

N70-40240* American Science and Engineering, Inc., Cambridge, Mass.
X-RAY REFLECTION COLLIMATOR ADAPTED TO FOCUS X-RADIATION DIRECTLY ON A DETECTOR Patent
Riccardo Giacconi and Bruno B. Rossi, inventors (to NASA) Issued 4 Aug. 1964 (Filed 23 Feb. 1961) 6 p Cl. 250-105 Sponsored by NASA
(NASA-Case-XHQ-04106; US-Patent-3,143,651;
US-Patent-Appl-SN-91180) Avail: US Patent Office CSCL 14B

An X-ray collimating structure positioned between the entrance aperture and the detector area has a series of optically smooth surfaces with each surface oriented at an angle of grazing incidence to radiation from a distant source, but at a slightly different angle from the other surfaces in the collimator. All of the surfaces are exposed to radiation from the distant source and are positioned to deflect impinging radiation onto the detecting area with a substantial degree of external reflection. The detector is an open cathode photomultiplier. R.B.

N70-40273* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRICALLY-OPERATED ROTARY SHUTTER Patent
Allen G. Ford, inventor (to NASA) Issued 16 Nov. 1965 (Filed 14 May 1963) 5 p Cl. 95-58 Sponsored by NASA
(NASA-Case-XNP-00637; US-Patent-3,217,624;
US-Patent-Appl-SN-280778) Avail: US Patent Office CSCL 14E

An electrically operated rotary shutter for a television camera aboard a spacecraft is described. The rotary blade shutter substantially reduces the effect of shutter bounce during the high speed photography requirements and provides an even exposure across the field of view. A solenoid responsive to an electrical pulsed signal moves the shutter blade through a suitable linkage to an open position and maintains it in the open position for the prescribed length of exposure time. Upon termination of the pulsed signal a U-shaped spring acts on the shutter blade through the same linkage to rotate the shutter in the same clockwise movement to the closed position. R.B.

N70-40299# ARO, Inc., Arnold Air Force Station, Tenn.
INVESTIGATION OF PERFORMANCE PARAMETERS OF A MASS SPECTROMETER SAMPLING PROBE IN RAREFIED FLOWS Final Report, Jan. – Oct. 1969
J. A. Benek and H. M. Powell AEDC Jun. 1970 46 p refs
(Contract F40600-69-C-0001)
(AD-707843; AEDC-TR-70-79) Avail: NTIS CSCL 14/2

The basic design parameters of a mass spectrometer sampling probe to be used in the investigation of highly expanded rocket motor exhaust plumes were investigated. The primary design considerations were determined to be large internal pumping capacity, skimmer interaction with the flow field, and test chamber performance. The scattering phenomena encountered in the operation of such a device were investigated. The position at which background pressure is measured was found to have significant effect on the value of the scattering parameter proposed by Fenn and Anderson. The scattering phenomena were investigated at several source skimmer separation distances and at various source conditions along the expansion centerline. Velocity distribution measurements in the rarefied flow regime were made. The speed ratio was unaffected until the transition regime was reached.
Author (TAB)

N70-40340# New York Univ., N.Y. School of Engineering and Science.
GEIGER COUNTERS: THEORY, OPERATION AND MANUFACTURE Final Report
Serge A. Korff 30 Apr. 1970 162 p
(Contract DAHC20-68-C-0137)
(AD-708922) Avail: NTIS CSCL 18/4

The report reviews the theory, operation and the constructional details of Geiger Counters. It discusses various types and recommends various manufacturing procedures. The fundamental characteristics of gas-discharge devices, and the details of quenching, the effects of gas fill and sizes and voltages are discussed.
Author (TAB)

N70-40400* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THERMO-PROTECTIVE DEVICE FOR BALANCES Patent
Vernon L. Rogallo, inventor (to NASA) Issued 23 Nov. 1965 (Filed 14 Aug. 1962) 6 p Cl. 73-147
(NASA-Case-XAC-00648; US-Patent-3,218,850;
US-Patent-Appl-SN-216939) Avail: US Patent Office CSCL 14B

The balance unit described has a self contained heat shield that is integral with balance, affords rapid change of test models, is simple in design, requires no maintenance of compensation, and eliminates the need for externally connected apparatus. The unit can be used with single or multi-component balances. A vacuum is used to improve insulation in combination with a heat sink to delay heat passage through the vacuum on contracting parts before the heat reaches the balance. The unit also permits relative movement with a slip joint for longitudinal expansion and ears for radial expansion, while maintaining the vacuum between the two containers.
E.H.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N70-39089# Sandia Corp., Albuquerque, N.Mex.
HOT-PRESSED FUSED-SILICA COMPOSITES
R. H. Dungan and J. A. Gilbert May 1970 26 p refs
(SC-DR-70-166) Avail: NTIS

A high temperature, induction heated vacuum hot press is described. Procedures for hot pressing fused silica tungsten compacts, containing both tungsten powder and fibers, are discussed. Generally, a temperature of 1200 C for 30 minutes at a pressure of about 3000 psi resulted in specimens of about 95 percent theoretical density. The most interesting characteristics of these materials are their increased melt viscosity and mechanical strength of tungsten-fiber-reinforced silica. Flexural strengths of specimens containing 30 volume percent fibers were about 28,000 psi, 4 times stronger than the unreinforced hot pressed control specimens. Heats of ablation when tested under various environmental conditions, along with other thermal properties, are also included.
NSA

N70-39169 Carnegie-Mellon Univ., Pittsburgh, Pa.
STEADY-STATE FLOW OF THE LIQUID DIELECTRIC AND THE DYNAMICS OF THE MACHINING BY-PRODUCTS IN THE ELECTRICAL DISCHARGE MACHINING PROCESS
Glenn James Grachis (Ph.D. Thesis) 1969 193 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-19093

In the electrical discharge machining (EDM) process, the metal removal is caused by the action of transient electrical discharges between the tool-electrode and the workpiece immersed under a dielectric liquid. During the EDM process, the spacing between the tool and workpiece always contains a combination of dielectric liquid and machining by-products. Some of the dynamics of the dielectric fluid, gaseous debris, and solid debris in the machining gap are investigated. Forced fluid flushing and servo flushing are investigated mathematically. The dynamics of the gaseous debris and solid debris are investigated by using the single spark discharge approach. With the information obtained from the above investigations, a model of the machining gap is proposed, and a computer simulation of the machining gap is developed. The machining results predicted by the computer simulation program are compared with machining results from commercial EDM machines.
Dissert. Abstr.

N70-39286*# Norton Research Corp., Cambridge, Mass.
VACUUM ADHESION AND ITS LUNAR MINING IMPLICATIONS
P. Blum and M. J. Hordon *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. 1970 p 93–99 refs
(See N70-39276 22-30)
(Contracts NAS1-5347; NAS7-100; NASw-1616; AF 04(611)-9717)
Avail: SOD $1.50; NTIS CSCL 13H

Selected equipment, procedures, and results from three experimental studies of vacuum adhesion are discussed: (1) self abrasion of basalt at 4 nanotorr to simulate lunar soil, (2) diamond wheel grinding of basalt at 0.1 and 4 torr to simulate extraterrestrial geological sampling, and (3) friction and adhesion of selected metals at .5 picotorr. Some of the implications are that a lunar vacuum may alter the size distribution of fractured rock, require increased energy and time to fragment it, and reduce the speed at which grinding, certain kinds of drilling, and other abrasion work can proceed. Remedies such as low pressure protective atmospheres and bearing surface lubricants are discussed, as well as their possible limitations.
Author

N70-39293*# Bureau of Mines, Minneapolis, Minn.
DEVELOPING A LUNAR DRILL: A 1969 STATUS REPORT
R. L. Schmidt *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 135–138 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 13I

The problems associated with lunar drilling are reviewed, and the status of the development program is summarized. The work at the Twin Cities Mining Research Center in connection with the program is discussed.
Author

N70-39294*# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
ELECTROWINNING OXYGEN FROM SILICATE ROCKS
D. G. Kesterke *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extra-Terrest. Resources 1970 p 139–144 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 13H

One phase of NASA-sponsored research for the utilization of extraterrestrial resources is directed toward determining the feasibility of extracting oxygen by electrolysis of simulated lunar materials. The method is based on a modification of existing techniques for electrowinning metals from their oxides in fused-salt systems. Results of preliminary work leading to the electrowinning efforts are presented. The current status of the research effort is outlined, and operating conditions are described under which oxygen was successfully electrowon from fluoride-silicate mixtures. Author

N70-39308*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METAL STRUCTURES WITH PARALLEL PORES OF UNIFORM SIZE
J. Sherfey Jul. 1970 19 p refs Submitted for publication
(NASA-TM-X-65326; X-735-70-307) Avail: NTIS CSCL 13H

A wide variety of techniques for preparing metallic structures with parallel, uniformly-sized pores is described critically. One such technique is a commercial process, and at the opposite extreme, others are, perhaps, totally impractical. The method of choice will depend on the characteristics of the structure to be fabricated. Some of the processes described are applicable to materials other than metals. Author

N70-39375*# General Dynamics/Convair, San Diego, Calif.
PROCESSES FOR SPACE MANUFACTURING: DEFINITION OF CRITERIA FOR PROCESS FEASIBILITY AND EFFECTIVENESS Final Report
W. H. Steurer and D. J. Gorham Huntsville, Ala. NASA Jun. 1970 282 p refs
(Contract NAS8-24979)
(NASA-CR-61334; GDC-DBG-70-001) Avail: NTIS CSCL 13H

The scientific and engineering criteria used in determining the feasibility and effectiveness of space manufacturing processes are defined, along with a research and development program for initial space manufacturing experiments. A total of 24 processes for space manufacturing are evaluated. The evaluation of each process analyzes the fundamental and technological criteria, defines the expected process and product capabilities, and outlines anticipated tooling requirements. The potentials, limitations, and priorities of each process are discussed in detail, and substantiating quantitative and qualitative data is included. Author

N70-39380 + Laboratorio de Acustica e Sonica, Sao Paulo (Brazil.)
ULTRASONIC INSPECTION OF STEEL PLATES DESTINED FOR USE AS FORCED TUBES IN THE PASSO REAL HYDROELECTRIC POWER PLANT [INSPECAO ULTRA-SONICA DE CHAPAS DE ACO DESTINADAS AO DUTO FORCADO DA USINA HIDRELETRICA DE PASSO REAL]
J. A. Perdiz and J. R. Costa 14 Jan. 1970 18 p In PORTUGESE; ENGLISH summary
(TR-7001.402) Avail: NTIS

The inspected materials, the equipment and accessories utilized, and the results of ultrasonic inspection of plates to be used as forced tubes in a hydroelectric power plant are described. The standards and specifications are presented; results are presented in schematics that indicate the defect position. Photographs of the echograms are included. Author

N70-39401*# TRW Systems Group, Redondo Beach, Calif.
ADVANCED SPACECRAFT VALUE TECHNOLOGY Final Report, Oct. 1968–May 1970
Jul. 1970 227 p refs Prepared for JPL
(Contract NAS7-717)
(NASA-CR-86435; TRW-12411-6011-R0-00) Avail: NTIS CSCL 13K

CONTENTS:

1. MECHANICAL CONTROLS NONMECHANICAL CONTROLS, AND TECHNOLOGY SUPPORT 41 p refs (See N70-39402 22-12)

2. THE FORMATION OF SURFACE FILMS BY ELECTRON BOMBARDMENT FINAL REPORT, OCT. 1968–SEP. 1969 M. W. Roberts, J. R. H. Ross, J. H. Wood, and W. J. Murphy (Bradford Univ.) 70 p refs (See N70-39403 22-06)

3. PHYSICAL AND CHEMICAL PROPERTIES OF THIN POLYMER FILMS FINAL REPORT, OCT. 1968–JAN. 1970 R. W. Christy and L. E. Babcock (Dartmouth Coll.) 36 p refs (See N70-39404 22-18)

N70-39423*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTICAL ANALYSIS OF BALL BEARING STARVATION
L. D. Wedeven, D. Evans, (Imperial Coll., London), and A. Cameron (Imperial Coll., London) [1970] 35 p refs Proposed for presentation at Lubrication Conf., Cincinnati, Ohio, 12-15 Oct. 1970; sponsored by ASME and Am. Soc. of Lubrication Engr.
(NASA-TM-X-52869) Avail: NTIS CSCL 13I

Elastohydrodynamic oil film measurements for rolling point contact under starvation conditions are obtained using optical interferometry. The experimental measurements present a reasonably clear picture of the starvation phenomenon and are shown to agree with theoretical predictions. Starvation inhibits the generation of pressure and, therefore, reduces film thickness. It also causes the overall pressure, stress and elastic deformation to become more Hertzian. Additional experiments using interferometry illustrate the cavitation pattern, lubricant entrapment, grease lubrication, ball spin, and edge effects in line contact. Author

N70-39447*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
GLOSSARY OF TERMS PERTINENT TO RELIABILITY AND QUALITY ASSURANCE AT KSC
1 Jun. 1970 101 p refs
(NASA-TM-X-66313; KSC-GP-850) Avail: NTIS CSCL 14D

The definitions as presented herein are intended to provide an updated collection of terms and acronyms used at KSC for reliability and quality assurance. The preferred usage is given; however, differences in definitions are found and are noted for comparison. Author

N70-39474 + Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION, DYE CHECK TESTING AND METALLOGRAPHIC ANALYSIS OF THE MATERIAL FOR TWO PINIONS [INSPECAO ULTRA-SONICA, EXAME COM DYE CHECK E ANALISE METALOGRAFICA DO MATERIAL DESTINADA A PINHOES DE GRANDE PORTE]
L. X. Napomuceno, M. F. Barbosa, and T. Momoi 23 Mar. 1970 7 p In PORTUGUESE; ENGLISH summary
(TR-7003.415) Avail: NTIS

The inspected parts, the equipment, accessories, procedures, and results obtained in the ultrasonic inspection, dye checks, and metallographic analysis of the material for two large pinions are described. The quality certificates are included. Author

N70-39478 + Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
SONIC TECHNIQUES IN PREVENTIVE MAINTENANCE IN PAPER AND CELLULOSE INDUSTRY [TECNICAS SONICAS

NA MANUTENCAO PREVENTIVA EM INDUSTRIA DE PAPEL E CELULOSE]
H. Onusic and L. F. Delbono 28 Aug. 1969 35 p refs In PORTUGUESE; ENGLISH summary
(Rept-89081E-017) Avail: NTIS

The possibilities of using sonic techniques for preventive maintenance in industry, particularly the paper and cellulose industry are presented. Some examples of inspection for corrosion control of tubes, boilers, and heat exchangers are described. The advantages of scheduled parts replacement for repairing or overhauling equipment are discussed with the safety aspects. Author

N70-39606*# General Dynamics/Convair, San Diego, Calif.
NONDESTRUCTIVE TESTING FOR SPACE SHUTTLE
T. J. De Lacy *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., vol. 5 Jul. 1970 p 45-72 (See N70-39603 22-31)
Avail: NTIS CSCL 13H

The nondestructive testing considerations for the shuttle may be divided into three general areas: (1) thermal damage, i.e., oxidation, properties degradation, local distortion; (2) fatigue damage, i.e., cycled loads - thermal, mechanical, acoustical; and (3) structural damage, other than fatigue, i.e., damage due to subcritical defects, accidents, and corrosion. On the exterior of the vehicle, the major areas of concern are leading edges and areas subject to repeated loads. For example, areas aft of flyback engines and forward of the rocket engines, including the entire aft section and stabilizers will be susceptible to sonic fatigue. Transducer arrays operating as passive detectors in critical attachment areas have been considered for inflight monitoring of crack initiation and propagation in these areas. While it is too early to determine the need for onboard sensing, the requirements for such a concept must be examined to perform tradeoffs necessary for the selection of materials and inspection approach. Author

N70-39660# Foster-Miller Associates, Inc., Waltham, Mass.
GAS FLOW CONTROL DEVICE FOR USE IN AEROSPACE THERMAL AND ATMOSPHERE CONTROL SYSTEMS Final Report, 15 Jun.-30 Nov. 1969
Seth R. Goldstein, Andrew G. Harvey, and Clemens M. Meyer (AMRL) Wright-Patterson AFB, Ohio AMRL Mar. 1970 45 p refs
(Contract F33615-69-C-1686)
(AD-708160; AMRL-TR-70-22) Avail: NTIS CSCL 13/7

The purpose of the work was to develop a small, lightweight oxygen flow control device able to deliver 2.65 + 0.05, -0.00 lb/hr oxygen at a nominal outlet pressure of 200 psig when supplied by an upstream pressure regulator and operated in ambient temperatures from -40F to +200F. The flow controller meters the oxygen through a variable area choked flow orifice. The orifice assembly consists of a rod, spring-loaded against a diaphragm and allowed to move axially inside a sharp edged hole. The variable orifice is formed by the gap between the edge of the hole and a flat machined on the periphery of the rod and inclined to the rod axis. Axial motion of the rod varies the gap, and therefore the orifice area. One side of the diaphragm is exposed to the upstream pressure of the orifice, and the opposite side is exposed to a trapped constant volume of gas having a pressure proportional to the gas temperature. The diaphragm deflection and the orifice area are linearly related to the pressure and temperature of the gas at the device inlet. Proper selection of the critical design values enables the variation of orifice area to compensate for changing inlet conditions. Author (TAB)

N70-39753# British Iron and Steel Research Association, London (England). Plant Engineering and Energy Div.
CONTROL OF GAUGE AND FLATNESS IN COLD STRIP ROLLING
J. W. Woodcock and B. Sabatini 20 Nov. 1969 14 p refs
(PB-190468; PE/B/34/69) Avail: NTIS CSCL 13H

The paper describes the work done at BISRA on the control of gage and shape in the cold rolling of strip. The theory for gage and shape control is summarized and experimental work to develop a combined gage/shape control is described. Author (USGRDR)

N70-39754# British Iron and Steel Research Association, London (England). Development and Information Service.
RAPID HEATING BY JET IMPINGEMENT METALLURGICAL IMPLICATIONS
T. D. Boxall and R. C. Willingham 6 Jan. 1970 17 p refs
(PB-190466; DIS/1/69) Avail: NTIS CSCL 13A

The report describes a metallurgical investigation into the jet impingement technique of rapidly heating steel billets for hot working. Six different steels were examined for decarburation, scaling and general surface quality and the results compared with similar steels heated in conventional reheating furnaces. The improved quality of billets heated by jet impingement is clearly demonstrated. Author (USGRDR)

N70-39812# Joint Publications Research Service, Washington, D.C.
PURIFICATION OF OIL-POLLUTED WASTE WATER URGED
In its Transl. on Eastern Europe Sci. Affairs, No. 131 16 Sep. 1970 p 2-7 refs Transl. into ENGLISH from Wirtsch. (East Berlin), 16 Jul. 1970 p 10 (See N70-39811 22-34)
Avail: NTIS

A facility for demulsifying used oil emulsions is described to show how legal regulations on contamination and pollution of water and air with industrial waste can be complied with. The oil emulsions used in the metalworking industry consist of mineral oils which are treated with emulsifiers and solubilizing additives, and mixed with water. The oil-bearing waste waters cannot be regenerated, and must meet specified limits of residual oil content before they can be discharged. Violation of the regulations results in price sanctions to the offending enterprise. R.B.

N70-39847# Academy of Sciences (USSR), Moscow.
STUDY OF THE OPERATIONAL CHARACTERISTICS OF THE N-5S PUMP WITH SORPTION TRAPS FOR THE OXIDIZED IRON
V. P. Konyaev, E. A. Maslennikov, and Yu. M. Pustovoit 1969 24 p refs In RUSSIAN
(IAE-1869) Avail: AEC Depository Libraries

The operating characteristics of the N-5S pump with an iron oxide trap are discussed. It was shown that the limiting vacuum is restored after heating the trap to 400 C even after an accidental burst of atmosphere from the prevacuation pump. Author (NSA)

N70-39888# Martin Marietta Corp., Denver, Colo. Center for High Energy Forming.
[EXPLOSIVE FORMING AND WELDING RESEARCH] Quarterly Technical Progress Report
Jimmy D. Mote 1 Apr. 1970 24 p Prepared in cooperation with Denver Univ.
(Contract DA-19-066-AMC-286(X); ARPA Order 720)
(AD-707942; AMRA-CR-66-05/23; QTPR-19) Avail: NTIS CSCL 13/8

The report summarizes results during the period 1 January thru 31 March 1970. Topics include: Measurement of the dynamic loads on an explosive forming die; Applications of explosive welding to hardware configurations; Flange buckling of explosively formed domes; Explosive punching of dual hardness armor; Cylindrical explosive forming dies; Explosive forming of domes in vented dies; Explosive forming of domes for ground based pressure vessels; The edge pull-in of explosively formed domes; Fracture toughness of

explosively formed high strength steels; Terminal properties of titanium; Explosive welding; Explosion welding of dual hardness armor; and Explosive powder compaction. Author (TAB)

N70-39896* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AIR BEARING Patent
Billy C. Hughes, inventor (to NASA) Issued 25 Dec. 1962 (Filed 16 May 1961) 5 p Cl. 308-9
(NASA-Case-XMF-00339; US-Patent-3,070,407; US-Patent-Appl-SN-110591) Avail: US Patent Office CSCL 13I

A bearing is described in which a small volume of low pressurized air is employed as a lubricant between surfaces. The plenum, thin porous membrane, and air bearing feeder orifice are arranged in such a manner that a relatively large percentage of air is passed by the restrictor directly to the bearing space without turbulence producing structures or construction. Substantially the entire orifice area is effectively employed; thus, a comparatively low volume of air is required while obtaining an even, laminar flow. It is stated that adverse effects of temperature variations and vibration are eliminated, and that the load carrying capacity in acceleration and vibration for a given volume of air is increased. The filter restrictor is spaced from the bearing surface, to eliminate torque producing influences, and the restrictor element is a multipore cellulosic membrane having a pore to substance ratio of approximately four. The device is particularly applicable to the bearings of gyros operating at high temperatures and in low fields of gravity, and where high dimensional stability is required, such as in space flight vehicles. P.A.B.

N70-39924* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SEGMENTED BACK-UP BAR Patent
William J. Franklin and Neil C. Martin, inventors (to NASA) Issued 18 Jan. 1966 (Filed 30 Jan. 1964) 9 p Cl. 228-50
(NASA-Case-XMF-00640; US-Patent-3,229,884; US-Patent-Appl-SN-341487) Avail: US Patent Office CSCL 13I

A back-up bar for use in butt welding cylindrical tubular structures such as large rocket boosters body or tank sections is described. The bar maintains uniform contact with the plates at opposite sides of the seam, retaining all molten metal in the seam and aiding in the alignment of the plates. The bar is also substantially self supporting, and is easily assembled from similar short arcuate segments and later disassembled for storage. N.E.N.

N70-40021*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLENOID VALVE Patent Application
Jack Evans, inventor (to NASA) Filed 10 Apr. 1970 13 p
(NASA-Case-GSC-10607-1; US-Patent-Appl-SN-27340) Avail: NTIS CSCL 13K

The poppet of a valve is guided independently of an activating armature. The poppet is linked to the armature through a nonmagnetic spring biasing mechanism. The spring biasing mechanism has a plunger which is inserted into a cone shaped cavity in the poppet. A guiding member guides both the armature and poppet independently of one another. The spring biasing mechanism causes the poppet to make contact with a valve seat before the armature completes its stroke to reduce the impact force. In addition, the valve seat and the poppet have unique contour shapes which are designed to reduce stresses. NSA

N70-40062* Pratt and Whitney Aircraft, East Hartford, Conn.
LIQUID-GAS SEPARATION SYSTEM Patent
William A. Prescott, inventor (to NASA) Issued 21 Dec. 1965 (Filed 31 Dec. 1964) 6 p Cl. 55-408 Sponsored by NASA
(NASA-Case-XMS-10824; US-Patent-3,224,173; US-Patent-Appl-SN-422867) Avail: US Patent Office CSCL 13G

A liquid-gas separator adapted to the extracting of liquid from a liquid-gas stream in a zero-gravity environment is described. This device includes a positive action valve for insuring the removal of only liquid from the mixture. The separator is of the centrifugal type and allows the liquid that is separated to be disposed, by centrifugal force, in an annular pool against the walls of the rotating bowl of the separator. A detailed description in connection with accompanying drawings is included. E.M.C.

N70-40082# Watervliet Arsenal, N.Y. Benet R and E Labs.
ULTRASONIC MEASUREMENT OF CRACK DEPTH IN THICK-WALLED CYLINDERS
James J. Miller Feb. 1970 34 p refs
(AD-707760; WVT-7017) Avail: NTIS CSCL 14/2

Fatigue testing of heavy-walled cylinders by cyclic internal pressure produces cracks in the bore. A program to study the propagation of these cracks required a non-destructive inspection technique to locate cracks and measure their depth at frequent intervals during testing. Watervliet Arsenal has developed an unusual method of ultrasonic inspection to perform this function using the sound energy reflected from a crack tip. An evaluation of the sensitivity of detection and accuracy of measurement of cracks is presented. Scanning the outside diameter of the cylinder with an ultrasonic normal-probe produces a response that can be readily interpreted in terms of crack depth, location, length and orientation. The method has also been successfully applied in the inspection of cannon tubes. Experience to date is limited to high strength steel cylinders with cracks 0.050 to 2.000 in. deep. However, with additional development, the technique offers possible application to other materials and configurations. At present all inspections are made and data recorded manually but an automatic system appears feasible and is currently under development. Author (TAB)

N70-40085# Stanford Univ., Calif. Dept. of Computer Science.
DESIGN OF A COMPUTER CONTROLLED MANIPULATOR
Victor David Scheinman Jun. 1969 65 p refs
(Contract ARPA SD-183)
(AD-708069; SU-AIM-92) Avail: NTIS CSCL 13/9

The report covers the preliminary system studies, the design process, and the design details associated with the design of a new computer controlled manipulator. A systems study of various manipulator configurations, force sensing methods, and suitable components and hardware was first performed. Based on this study, a general design concept was formulated. This concept was then developed into a detailed manipulator design, having six degrees of freedom, all electric motor powered. The manipulator has exceptionally high position accuracy, comparatively fast feedback servo performance, and approximately human arm reach and motion properties. Supporting some of the design details and selections are several examples of the design calculation procedure employed. Author (TAB)

N70-40099# San Jose State Coll., Calif. Dept. of Civil Engineering and Applied Mechanics.
STUDY OF ENTANGLEMENT PROBABILITY AMONG LONG VERTICAL LINES IN OCEAN Final Report, 14 Feb.– 1 Aug. 1969
Theodore C. Zsutty Apr. 1970 97 p refs
(Contract N62399-69-C-0014)
(AD-708034; NCEL-CR-70.009) Avail: NTIS CSCL 13/10

The study provides reliability information related to the problem of line entanglement in vertical, multi-line, weight raising systems in a turbulent ocean. Turbulence is modeled as a vertical field of stationary normal random processes with a given cross-spectral density function matrix. The vertical line is modeled as a linear, lumped-parameter system. Engineering values may be assigned to the constant parameters in both the turbulence spectral density matrix and the system response function matrix. Frequency domain analysis provides the horizontal displacement spectral density function matrix, and a discrete representation of spectral density

allows a closed form summation expression for the expected rate of zero displacement crossings. The Poisson distribution is assumed for the calculation of the probability of crossing a given displacement limit during a given time interval. Results are tabulated for the evaluation of safe spacing distances for given high, medium, and low turbulence conditions and line system properties. A deterministic analysis is made for the effect of vertical surface wave motion on horizontal displacement. A preliminary development deals with the numerical simulation of the vertical turbulence field. Author (TAB)

N70-40151# Illinois Univ., Urbana. Dept. of Metallurgy and Mining Engineering.
SPARK EROSION CUTTING OF GERMANIUM
R. P. Walson, W. L. Haworth, and H. K. Birnbaum 1 Jul. 1970 10 p
(Contract N00014-67-A-0305-0016)
(AD-708756) Avail: NTIS CSCL 11/6

The conditions for machining germanium by the spark erosion technique are established. The effects of this machining on the structure of the crystal are studied by etch pitting. Under proper conditions minimal damage to the crystal results. This technique appears to have the advantages of speed, minimal surface damage and flexibility in the shape of the cut. Author (TAB)

N70-40156* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MINIATURE VIBRATION ISOLATOR Patent
David H. Butler and Wilbert C. Falk, inventors (to NASA) Issued 14 Dec. 1965 (Filed 23 May 1963) 5 p Cl. 248-358
(NASA-Case-XLA-01019; US-Patent-3,223,374; US-Patent-Appl-SN-282817) Avail: US Patent Office CSCL 13I

A miniature vibration isolator adapted for use in attaching compact equipment packages to support structures is described. Advantages of the vibration isolator for miniaturization technology include a minimum number of simply designed parts, assembly in compact areas, and adaptability to various size requirements. Elastic tubing material is utilized which buckles under compression to form beads of resilient material between members being isolated. Figures of equipment utilizing the vibration isolators are given. J.M.

N70-40180* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NULL-TYPE VACUUM MICROBALANCE Patent
Vernon L. Rogallo, inventor (to NASA) Issued 21 Dec. 1965 (Filed 9 Nov. 1962) 12 p Cl. 73-142
(NASA-Case-XAC-00472; US-Patent-3,224,263; US-Patent-Appl-SN-236749) Avail: US Patent Office CSCL 13I

A null-type vacuum microbalance, employing a compound pendulum, for detecting and measuring minute mechanical displacements is described. In the measurement of small corpuscular or ionic beams, it is desirable to use a measuring instrument or balance, which can be operated without calibration, and which is completely free of moving parts such as pivots, bearings, knife edges or the like that would introduce sources of error into the balance, this device satisfies these requirements. In addition, this microbalance can operate at room temperatures under varying pressure conditions, ranging from extremely high vacuums to above atmospheric pressures. It provides for the measurement of extremely small forces or relatively large forces by quick adjustments of the balance, and operates independently of parts having more than a negligible amount of frictional resistance. Detailed description and accompanying drawings of the device are included. E.M.C.

N70-40204* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FLEXIBLE BACK-UP BAR Patent
Aubrey S. Drummond, inventor (to NASA) Issued 23 Nov. 1965 (Filed 26 Feb. 1964) 7 p Cl. 228-50
(NASA-Case-XMF-00722; US-Patent-3,219,250; US-Patent-Appl-SN-347626) Avail: US Patent Office CSCL 13H

A back-up bar for use in welding cylindrical or other awkwardly shaped structures is described; the bar readily conforms to almost any shape and may be folded into a compact shape for storage. Thin plates, contiguously arranged in a face to face relationship, form with their outer orientated edges, a backup contact surface, which is to be pressed against the surfaces of the structures to be joined at opposite sides of the seam or joint. The thin plates are held in their substantially laminated position by an elastomeric ribbon member to which the inner orientated edges of the plates are secured. The outer edge of each plate may have a center groove to receive the molten metal from the seam joint during the welding operations, to form a bead along the underside of the weld. A modification for greater transverse flexibility is also described, in which each single plate is replaced by two shorter plates of the same width. P.A.B.

N70-40213# Defense Documentation Center, Alexandria, Va.
MACHINE SHOP PRACTICE, VOLUME 1 Report Bibliography, Apr. 1954–Oct. 1969
May 1970 90 p refs
(AD-707200; DDC-TAS-70-55-1) Avail: NTIS CSCL 13/8

References in this bibliography relate to techniques, procedures, manufacturing methods, time studies and shop layout in machine shop practice. The performance capabilities and effectiveness of machine cutting, drilling, grinding, reaming, forming, spinning and shearing are discussed. References dealing with automation and shop maintenance procedures are also included. Corporate Author-Monitoring Agency, Subject, Title, and Personal Author indexes are included. Author (TAB)

N70-40214# Mechanical Technology, Inc., Latham, N.Y.
A TWO PHASE FLOW ROTOR BEARING SYSTEM: EXECUTION OF AN EXTENDED (500 HOUR) TEST Progress Report, 1 Jan. 1969–31 Mar. 1970
E. F. Finkin and S. Malanoski Apr. 1970 20 p refs
(Contract AT(30-1)-3839)
(MTI-70-TR-33; NYO-3839-9) Avail: NTIS

Activities in a program to develop design data and guidelines for the introduction of two-phase flow steam-lubricated bearings in turbomachines are summarized. Information is included on steam supply system development and instrumentation design. Information is also included on compressed air tests and 500 hour endurance tests. NSA

N70-40354* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DOUBLE-ACTING SHOCK ABSORBER Patent
Josef Frarer Blumrich, inventor (to NASA) Issued 11 Jan. 1966 (Filed 26 Mar. 1964)
(NASA-Case-XMF-01045; US-Patent-3,228,492; US-Patent-Appl-SN-355130) Avail: US Patent Office CSCL 20K

A shock absorber system is described which is operable over a single load cycle and utilizes a crushable energy dissipating material especially well adapted for the landing gear of a vehicle in nonterrestrial landing. The fluid in the usual shock absorber is replaced with a crushable material, such as honeycomb, balsa wood, or foamed material. The crushable material is placed between two moveable plates and on both sides of a moveable load plate. This assembly is mounted within a tubular container so that when a load is applied in one direction, part of the material is crushed. If, after the initial energy is dissipated, a force is applied in the opposite direction, the remaining material is crushed between the other moveable plate and the load plate. The shock absorber is inexpensive, rugged, dependable, lightweight, and can be adapted to such terrestrial uses as automobile bumpers and car stoppers on railway spur lines. N.E.N.

N70-40371# Defense Documentation Center, Alexandria, Va.
MATERIAL FORMING AND MATERIAL REMOVAL, VOLUME 1 A DDC Bibliography, March 1960–July 1969
Jun. 1970 180 p refs
(AD-707800; DDC-TAS-70-50-1) Avail: NTIS CSCL 13/8

The bibliography, Volume 1 of 3 volumes, comprises 128 annotated citations of unclassified and unlimited reports dealing with methods of material forming and material removal as applied to stainless steel, nickel alloys, cobalt alloys, titanium alloys, and aluminum alloys. The various methods of material forming and removal were used in the manufacture of airframes, projectiles, gun barrels, machine tools, and aerospace structures. Corporate Author-Monitoring Agency, Subject, Personal Author, Contract, and Report Number indexes are provided. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N70-39138 Michigan Univ., Ann Arbor.
MULTI-MODE LASERS IN INTERFEROMETRY AND HOLOGRAPHY
Carl Chris Aleksoff (Ph.D. Thesis) 1969 196 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-17955

Coherence effects such as the static fringe visibility in interferometry, and the image brightness in holography are emphasized in terms of spectral properties of light. Beside developing general equations to calculate the static visibility curve, the form of the static visibility curve for rectangular, Gaussian, binomial, and FM distributions of the longitudinal mode intensities are considered. The effect on the static visibility of mode pulling, modulation of the laser light, and mode structure drift were considered. Expressions for the static visibility were also described for degenerate and nondegenerate mode combinations for multitransverse and multilongitudinal mode lasers. The near coherence depth is primarily associated with the mode distributions or the bandwidth, while the far coherence depth is associated with the width of the modes or the bandwidth occupancy. The magnitude squared of the Fourier transform of a cross-spectrum gives the brightness of the hologram reconstruction. Dissert. Abstr.

N70-39392*# Stanford Univ., Calif. Microwave Lab.
INVESTIGATION OF LASER DYNAMICS, MODULATION AND CONTROL BY MEANS OF INTRA-CAVITY TIME VARYING PERTURBATION Quarterly Status Report, 1 May–31 Jul. 1970
S. E. Harris Jul. 1970 50 p refs
(Grant NGL-05-020-103)
(NASA-CR-86434; ML-1875; QSR-11) Avail: NTIS CSCL 20E

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1. ELECTRONIC TUNING AND SHORT PULSING OF DYE LASERS D. J. Taylor and S. E. Harris p 2–10 (See N70-39393 22-16)

2. ANALYSIS OF DYE LASER TUNED BY ACOUSTO-OPTIC FILTER W. Streifer and J. R. Whinnery p 11–23 refs (See N70-39394 22-16)

3. ABSORPTION COEFFICIENT, TRANSITION PROBABILITY, AND COLLISION BROADENING FREQUENCY OF DIMETHYLETHER AT He-Xe LASER 3.51 MICRON WAVELENGTH S. C. Wang and A. E. Siegman p 24–31 refs (See N70-39395 22-16)

4. OBSERVATION OF AN ENHANCED LAMB DIP WITH A PURE Xe GAIN CELL INSIDE A 3.51 MICRON He-Xe LASER S. C. Wang, R. L. Byer, and A. E. Siegman p 32–42 refs (See N70-39396 22-16)

5. PUMP LINEWIDTH REQUIREMENT FOR OPTICAL PARAMETRIC OSCILLATORS J. F. Young, R. B. Miles, S. E. Harris, and R. W. Wallace (Chromatix, Inc.) p 43–48 refs (See N70-39397 22-16)

N70-39393*# Stanford Univ., Calif.
ELECTRONIC TUNING AND SHORT PULSING OF DYE LASERS
D. J. Taylor and S. E. Harris *In its* Invest. of Laser Dyn., Modulation and Control by Means of Intra-Cavity Time Varying Perturbation Jul. 1970 p 2–10 (See N70-39392 22-16)
Avail: NTIS CSCL 20E

The insertion of an acousto-optic filter into the cavity of a dye laser is outlined for the development of an electronically tunable coherent light source. The fabrication and assembly of system components are described as well as Rhodamine dye experiments with center wavelengths of 5900 A and 6328 A. Alignment techniques developed from experimental runs are also discussed. J.M.

N70-39394*# Stanford Univ., Calif. Microwave Lab.
ANALYSIS OF DYE LASER TUNED BY ACOUSTO-OPTIC FILTER
William Streifer and John R. Whinnery *In its* Invest. of Laser Dyn., Modulation and Control by Means of Intra-Cavity Time Varying Perturbation Jul. 1970 p 11–23 refs Sponsored in part by NSF (See N70-39392 22-16)
Avail: NTIS CSCL 20E

A model of a dye laser electronically tuned by an acousto-optic filter is analyzed. Chirping modes are superposed to yield a steady-state periodic solution which predicts a shift of the spectrum to the high end of the filter band, and appreciable spectral narrowing. For the example considered, the theory predicts a narrowing factor of 100. Author

N70-39395*# Stanford Univ., Calif. Microwave Lab.
ABSORPTION COEFFICIENT, TRANSITION PROBABILITY, AND COLLISION BROADENING FREQUENCY OF DIMETHYLETHER AT He-Xe LASER 3.51 MICRON WAVELENGTH
S. C. Wang and A. E. Siegman *In its* Invest. of Laser Dyn., Modulation and Control by Means of Intra-Cavity Time Varying Perturbation Jul. 1970 p 24–31 refs (See N70-39392 22-16)
Avail: NTIS CSCL 20E

The pressure dependence of the absorption coefficient of dimethylether (DME) gas at He-Xe laser 3.508 micron wavelength is measured. The experimental results are in fairly good agreement with theory. A collision broadening frequency of 1.6 + or − .1 × 10 to the 8th power/sec at 15 torr, 293 K and a transition lifetime of 2.2 + or − .2 sec are obtained. A saturation intensity of about 2 mW/sq cm for 1 torr of DME is also estimated. Author

N70-39396*# Stanford Univ., Calif. Microwave Lab.
OBSERVATION OF AN ENHANCED LAMB DIP WITH A PURE Xe GAIN CELL INSIDE A 3.51 MICRON He-Xe LASER
S. C. Wang, R. L. Byer, and A. E. Siegman *In its* Invest. of Laser Dyn., Modulation and Control by Means of Intra-Cavity Time Varying Perturbation Jul. 1970 p 32–42 refs (See N70-39392 22-16)
Avail: NTIS CSCL 20E

The observation of an enhanced Lamb dip is reported for a pure Xe-136 gain tube in a He-Xe-136 laser cavity. The pure Xe gain cell is operated at a pressure of 5 mtorr so that pressure broadening effects are negligible. The observed enhanced Lamb dip has a 5 MHz width and a depth which is 10% of the peak power. It is estimated that frequency stabilization at 3.5 micron to one part in 10 to the 11th power is possible using the enhanced Lamb dip as a reference. Author

N70-39397*# Stanford Univ., Calif. Microwave Lab.
PUMP LINEWIDTH REQUIREMENT FOR OPTICAL PARAMETRIC OSCILLATORS
J. F. Young, R. B. Miles, S. E. Harris, and R. W. Wallace (Chromatix, Inc.) *In its* Invest. of Laser Dyn., Modulation and Control by Means of Intra-Cavity Time Varying Perturbation Jul. 1970 p 43–48 refs (See N70-39392 22-16)
(Contract F19628-70-C-0057)
Avail: NTIS CSCL 20E

A pumping laser at 0.473 micron having a bandwidth of about 4/cm was used to construct a parametric oscillator having a bandwidth of about 0.25/cm and tunable from about 2.45 microns to 3.2 microns. It is shown that for such an oscillator there is a significant advantage in resonating the IR wave instead of the visible wave. Author

N70-39597# North American Aviation Science Center, Thousand Oaks, Calif.
MEASUREMENT OF LASER ENERGY AND POWER
George Birnbaum and Milton Birnbaum (Aerospace Corp., El Segundo, Calif.) *In* NBS Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 393–398 refs Prepared in cooperation with Aerospace Corp., El Segundo, Calif. (See N70-39551 22-09)
Avail: SOD $5.50

Measurements of laser energy and power are discussed with emphasis on those methods which attempt to establish the accuracy or standards for such measurements. Devices to attenuate laser radiation are summarized. The principles and limitations of the methods are stressed. It is found that standards for the measurement of laser power and energy are yet to be definitely established. Thus caution should be exercised in accepting stated accuracies for laser output measurements. Author

N70-39598# National Bureau of Standards, Boulder, Colo.
CALORIMETRIC MEASUREMENT OF PULSED LASER OUTPUT ENERGY
D. A. Jennings *In its* Precision Meas. and Calibration, Vol. 4 Jun. 1970 p 399–402 refs Presented at 1968 Conf. of Precision Electromagnetic Meas., Boulder, Colo. (See N70-39551 22-09)
Avail: SOD $5.50

The heart of the calorimeter is a small absorption cell containing an aqueous solution of CuSO4. The temperature of the absorption cell, as measured by a thermocouple, indicates the energy absorbed by the calorimeter. The calorimeter was calibrated in two different ways: (1) the known heat capacity of the absorption cell and the thermocouple sensitivity calibration gives a calorimeter calibration, which agrees within 0.3 percent of (2) an electrical energy substitution calibration which is obtained via a heater wire contained in the absorption cell solution. This specific calorimeter was designed to measure energies up to 30 J and will take peak powers of up to 200 MW/sq cm. Author

N70-39617# McElroy (Ralph) Co., Austin, Tex. Custom Div.
LASER AMPLIFICATION IN A DIVERGENT BEAM WITH A CONICAL ROD
J. M. Jego [1970] 4 p refs Transl. into ENGLISH from App. Opt., v. 9, Jan. 1970 p 225–227 Prepared for Calif. Univ., Livermore. Lawrence Radiation Lab.
(UCRL-Trans-10466) Avail: NTIS

A laser amplification theory is proposed to improve the energy efficiency in glass rods by using conical amplifiers where the beam to be amplified is made divergent with a lense. Transfer equations are included. E.H.W.

N70-39932# Harry Diamond Labs., Washington, D.C.
UNUSUAL HYPERFINE SPECTRA OF Yb(3+) IN SCHEELITES
Joseph P. Settler and Joseph Nemarich Apr. 1970 19 p refs
(AD-707928; HDL-TR-1486) Avail: NTIS CSCL 7/4

The tetragonal X-band electron paramagnetic resonance spectrum of Yb3+ shows an unusual hyperfine spectrum in the laser host scheelite crystals SrWO4, SrMoO4, PbWO4, and PbMoO4. For these crystals the principal 2I + 1 hyperfine absorption lines of the parallel spectrum do not go continuously into the 2I + 1 lines of the perpendicular spectrum as the angle of the magnetic field is varied from the crystal c-axis. At some angles more than the usual 2I + 1 transitions are observed. This unusual behavior is completely explained by the axial spin-Hamiltonian and the relatively large ratio of B/A for Yb3+ in these crystals. Author (TAB)

N70-40145*# Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
RESEARCH DIRECTED TOWARD PERFECTING A DESIGN FOR A SPACE QUALIFIED He-Ne LASER, PHASE 2
William P. Kolb Washington NASA Sep. 1970 99 p refs
(Contract NAS12-579)
(NASA-CR-1664) Avail: NTIS CSCL 20E

The laser and power supply, which are integrated into a single package, provide a rugged, lightweight, compact unit. The design details of the unit are presented. The results of special studies conducted in cold cathode geometry and lifetests; internal mirrors; mirror and window seals; and environmental testing are reported. Fundamental design problems were encountered in testing lasers of this design. Problem investigations and proposed solutions are discussed and results from testing a modified laser are reported. The entire space laser program is summarized and presented. Author

N70-40219# Yale Univ., New Haven, Conn. Dept. of Physics.
ATOMIC AND MOLECULAR SPECTROSCOPY WITH LASERS Final Report, 1 Apr. 1968–31 Dec. 1969
Vernon W. Hughes, William R. Bennett, Jr., Willis E. Lamb, Jr. 20 Apr. 1970 26 p refs
(Grant AF-AFOSR-1562-68)
(AD-707887; AFOSR-70-1132-TR) Avail: NTIS CSCL 7/4

Techniques were developed for application of lasers to two fundamental experiments in atomic spectroscopy: Fine structure of positronium n = 2 state; Vibrational spectrum of the hydrogen molecular ion HD(+). Author (TAB)

N70-40242# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH INVESTIGATION OF PICOSECOND LASER PULSES Quaterly Technical Report, 1 Mar.–31 May 1970
Anthony J. De Maria, William H. Glenn, George L. Lamb, Jr., Michael E. Mack, and E. Brian Treacy 26 Jun. 1970 33 p refs
(Contract N00014-66-C-0344; ARPA Order 306-14-15)
(AD-707744; UACRL-J920479-23) Avail: NTIS CSCL 20/5

The report describes experimental investigations of fast pumping sources for organic dye lasers, analytical investigations of nonlinear propagation effects in Kerr active liquids, analyses of coherent propagation effects and investigations of the phase structure of picosecond pulses. TAB

N70-40270# Westinghouse Research Labs., Pittsburgh, Pa.
OPTICAL PUMPING OF LASERS Final Report, 1 Jun. 1969–31 Mar. 1970
Lyle H. Taylor, Irving Liberman, Richard Liebermann, Alex Federowicz, and Lloyd Armstrong, Jr. 31 May 1970 185 p refs
(Contract N00014-69-C-0428; ARPA Order 1312)
(AD-707747; FR-70-9-C1-SOOPL-R3) Avail: NTIS CSCL 20/5

The emission spectra of 40-amp 2.5 atm xenon and krypton arc discharges are calculated. The spectral overlap of these spectra and the measured emission spectra of tungsten and potassium-mercury arc discharges with the measured absorption spectra of Nd:YAG are used to determine relative system efficiencies which agree well with measured values. It is found that the K-Hg lamp is four times more efficient in pumping Nd:YAG than the

studied W, Kr, and Xe lamps. The spectral overlap calculation for a nominal ruby oscillator-amplifier at the peak of the flash lamp pulse gives a pump efficiency which is much higher than measured system efficiencies. This discrepancy may be caused by the time dependent behavior of the flash lamp pulse and the oscillator pulse. A new technique is developed to obtain electronic radial wave functions from known radial integrals. In a test case, the Cu 4s wave function is determined within plus or minus 8%. Group theory is applied to the calculation of radial integrals involving hydrogen wave functions and some selection rules are explained. Author (TAB)

N70-40347# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE STRESS STATE CAUSED BY A LASER BEAM DURING THE RUPTURE OF TRANSPARENT POLYMERS
G. V. Pliatsko et al [1970] 6 p refs Transl. into ENGLISH from Fiz.-Khim. Mekhan. Materialov, Akad. Nauk Ukr. SSR (Kiev), no. 3, 1970 p 93–97
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The investigation of the stress state is approached from the aspect of the mechanics of a deformable solid. Experimental results and assumptions on the spatial and time distributions of the absorbed laser beam energy are utilized in compiling the computational model. It is assumed that the process of beam energy conversion into mechanical strain energy occurs instantaneously and results in the origination of centers of expansion, located in planes perpendicular to the beam axis and with maximum intensity on the axis. On this basis, the problem of origination of stress waves in an infinite body due to the instantaneous absorption of electromagnetic energy in a thin circular domain with maximum intensity in the central section is examined. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N70-39124# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
SOLID-LIQUID PHASE EQUILIBRIA IN THE POTASSIUM-CESIUM SYSTEM Technical Progress Report, 1 Sep. 1969–31 Aug. 1970
J. Rex Goates, J. Bevan Ott, and H. Tracy Hall, Jr. 15 May 1970 8 p refs
(Contract AT(11-1)-1707)
(COO-1707-8) Avail: NTIS

Thermal methods were used to determine in detail the solid-liquid phase equilibria diagram for the potassium-cesium system. The system is a solid solution of continuously varying composition. The minimum in the liquidus curve occurs at 235.12 K and 0.498 + or − 0.005 mole fraction cesium. Occurrence of the minimum so near to the 1:1 composition suggests the possibility of a 1:1 intermetallic compound. Author

N70-39135 University of Southern Calif., Los Angeles.
ANELASTICITY IN COPPER AND ALUMINUM SUBJECTED TO NEUTRON IRRADIATION AND FATIGUE
Ferdinand Charles Strible, Jr. (Ph.D Thesis) 1969 326 p
Avail: Univ. Microfilms: HC $14.85/Microfilm $4.20 Order No. 69-19408

The phenomenology of fatigue and neutron irradiation in metals was investigated by correlating the effects of these phenomena with internal friction. Controlled experiments were conducted in which polycrystalline specimens of pure copper and pure aluminum were subjected to four known increments of fast neutron irradiation and were fatigued in rotating bending. At selected intervals, fatigue was interrupted to measure the internal friction in a torsion pendulum. Shortly before fatigue failure, internal friction was also measured at intervals of elevated temperature to investigate the effect of fatigue on thermally activated relaxation behavior. Fatigue was found to cause significant changes in the internal friction of both copper and aluminum. Neutron irradiation substantially reduces the internal friction of copper and minimizes the peak, trough, and plateau formations. Although the internal friction of irradiated copper increases during fatigue, it seldom attains the same value as that of the unirradiated copper at failure. Dissert. Abstr.

N70-39167# California Inst. of Tech., Pasadena. W.M. Keck Lab. of Engineering Materials.
TEMPERATURE AND FIELD DEPENDENCE OF MAGNETIZATION OF AMORPHOUS (Fe, Mn)-P-C ALLOYS
Ashok K. Sinha Jul. 1970 18 p refs *Its* AEC Res. and Develop. Rept. No. 6
(Contract AT(04-3)-822)
(CALT-822-7) Avail: NTIS

Amorphous quasi-binary alloys having the composition (Fe(1-x)Mn(x))0.75P(0.15)C(0.10), where 0.0 < or = x < or = 1.0, were synthesized by rapid quenching from the liquid state. Their magnetic behavior was characterized by measurements of the magnetization as a function of temperature in the range 4.2 to 300 K, and in fields ranging from 1 to 8.5 kOe. The iron-rich alloys with 0.0 < or = x < or = 0.4 are ferromagnetic; the magnetic moment at 0 K decreases linearly. Judging from the large values of the ratio of the number per mole of magnetic carriers in the paramagnetic state to that in the ferromagnetic state, and also from the non-saturating behavior of magnetization with field at 4.2 K, it appears that the ferromagnetism in these alloys may be of the itinerant kind. Alloys having 0.5 < or = x < or = 1.0 possess considerably more complex magnetic structures. They are characterized by a peak in the magnetization curve at temperatures between 15 and 40 K, and a ferrimagnetic type curvature in the Curie-Weiss plots. This kind of magnetic behavior is tentatively ascribed to ferrimagnetism existing in conjunction with parasitic antiferromagnetism over some local regions in the amorphous structure. Author

N70-39170 Rensselaer Polytechnic Institute, Troy, N.Y.
THE EFFECT OF MINOR ELEMENTS ON THE HOT CRACKING TENDENCIES OF INCONEL 600
Gene Merle Goodwin 1969 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-17906

This investigation was undertaken to determine the effect of six minor elements, sulfur, phosphorous, silicon, manganese, titanium and aluminum, on the hot cracking propensity of Inconel, a solid-solution strengthened nickel-base alloy. A technique was developed which allowed the preparation of a large number of specimens of systematically varied composition by the incorporation of compacted and sintered powder inserts containing the desired impurity additions. A full factorial experiment was then performed, utilizing all of the sixty-four possible combinations of the six intentionally added minor elements. The entire testing program was replicated once at two levels of augmented strain, giving an accurate estimate of error. Using the method of Yates and the analysis of variance, the significant effects of the six minor elements were determined for three cracking parameters, the total crack length, the maximum crack length, and the average crack length. Dissert. Abstr.

N70-39190# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
CRYOGENIC BERYLLIUM BIAXIAL STRESS TEST, DATA ITEM T-119 Final Development Test Report

W. H. Baker, R. Kesterson, and D. G. Opdycke Apr. 1970 70 p refs
(WANL-TME-1986) Avail: NTIS

Uniaxial and biaxial beryllium specimens were stressed to failure at −320 F (approximate reflector inlet temperature) and the results compared. The hollow beryllium biaxial test specimens were simultaneously subjected to axial and hoop stresses of a 1:1 ratio at the specimen ID. Each test was run until the specimen is fractured. The experimental data were analyzed and compared with various theories of failure. Only three of the four biaxial specimens of the same material stock were compared and the data were scattered and fell between the Stassi d'Alia and the Von Mises theories of failure. Author (NSA)

N70-39224# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
HIGH-PRESSURE PHASE STUDIES ON SODIUM, POTASSIUM, RUBIDIUM, AND CESIUM METALS AND ON SODIUM-POTASSIUM ALLOYS Technical Progress Report, 1 Sep. 1969 – 31 Aug. 1970
Donald Ray Anderson, J. Bevan Ott, J. Rex Goates, and H. Tracy Hall, Jr. 15 May 1970 15 p refs
(Contract AT(11-1)-1707)
(COO-1707-9) Avail: NTIS

The solid-liquid phase diagrams are investigated to 60 kbars for elemental sodium, potassium, rubidium, and cesium, and for various sodium-potassium alloys. The data for Na, K, and Rb are in agreement with earlier workers. Our Cs melting points, however, are considerably higher than the literature values. In the sodium-potassium alloy system, the peritectic and eutectic halts intersect at 35 kbars and 343 C. Above this pressure, two halts are observed, one of which increases while the other decreases with increasing pressure to 55 kbars where it abruptly starts increasing again. Melting points in the 0.6 – 0.8 mole fraction potassium range indicate that an NaK2 intermetallic compound may form at high pressures. Author

N70-39230*# Techtran Corp., Glen Burnie, Md.
SCALE RESISTANCE OF ALLOYS IN THE TERNARY SYSTEM Ni-Al-Cr [OKALINOSTOYKOST SPLAVOV TROYNOY SISTEMY NIKEL-ALYUMINIY-KHROM]
A. S. Tumarev et al Washington NASA Sep. 1970 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 9, 1959 p 125 – 131
(Contract NASw-2037)
(NASA-TT-F-13221) Avail: NTIS CSCL 11F

The scale resistance of about 50 alloys of nickel with aluminum and chromium is studied with aluminum and chromium contents of up to 20%. The scale resistance is measured as a function of composition for binary alloys of nickel with aluminum and with chromium, and for ternary alloys with a number of constant contents of aluminum and chromium. These results are used as the basis for a ternary state diagram of scale resistance in the nickel-aluminum-chromium system for the area adjacent to the nickel corner of the concentration triangle and for a broad interval of change of concentrations of aluminum and chromium. Author

N70-39241# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SOME EFFECTS OF COLD-WORKING, THERMAL AGING, AND REACTOR IRRADIATION ON ULTRASONIC WAVES VELOCITY AND ATTENUATION IN SOME AUSTENITIC STEEL TENSILE-CREEP SPECIMENS
D. O. Hunter May 1970 33 p refs
(Contract AT(45-1)-1830)
(BNWL-1371) Avail: NTIS

For nondestructive testing purposes, austenitic steel specimens which were cold worked, thermally aged, or fast flux irradiated were measured for effects on ultrasonic wave velocity and attenuation. This report presents a summary of ultrasonic measurements made on tensile-creep specimens of irradiated Types 304 and 348 stainless steel (SS), cold-worked Types 304 and 316 SS, and thermally aged Type 304 SS. Cold working was found to affect both attenuation and velocity; the direction and amount of change depended on the type of steel alloy, the percentage of cold-working and the frequency of ultrasonic waves. Thermal aging had negligible effect on velocity and attenuation. Neutron bombardment to high fluences at high irradiation temperatures (825 to 1180 F) typically caused decreases in velocity. Author (NSA)

N70-39268# Aerospace Corp., El Segundo, Calif.
THE USE OF KNOOP HARDNESS TO DETERMINE THE YIELD LOCI OF Ti-6Al-4V, January - September 1969
Maurice F. Amateau and Louis Raymond 15 Feb. 1970 36 p refs
(Contract F04701-69-C-0066)
(AD-707108; TR-0066(5250-10)-14; SAMSO-TR-70-175) Avail: NTIS CSCL 11/6

Yield stress loci of Ti-6Al-4V processed to various degrees of anisotropy were determined from Knoop hardness numbers. Two methods of calculation were used, and the results were compared with uniaxial tensile values and Hills theory of anisotropic yielding. Anisotropy ratios, expressed in terms of R values, were determined independently of the hardness method by strain measurements in the three principal directions. For the R values of 6 and greater, the shape of the yield loci as determined by Knoop hardness did not agree with uniaxial tensile results. For R values less than 3, the shape of the yield loci was relatively insensitive to variations in the hardness values, indicating that any agreement with conventionally determined loci may be fortuitous. Author (TAB)

N70-39344 Missouri Univ., Rolla.
THE IRON-HOLMIUM BINARY STYSTEM AND RELATED MAGNETIC PROPERTIES
Gerald John Roe (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-19429

The iron-holmium binary system was determined by three experimental techniques, differential thermal analysis, X-ray diffraction, and metallography. A phase diagram with three eutectic points and four intermediate phases was constructed from the experimental data. The two phases, Ho6Fe23 and Ho2Fe17, melted congruently at 1332 C and 1343 C respectively. HoFe2 and HoFe3 melted incongruently at 1288 C and 1293 C respectively. Neutron diffraction investigations were made on the intermediate phases Ho6Fe23 and HoFe2 to obtain information on their magnetic structures. From the plots of magnetic ordering vs temperature, the Curie temperature of Ho6Fe23 was placed at 500 K, and that of HoFe2 at 600 K. The magnetic and chemical cells of Ho6Fe23 were coincidental, while the magnetic cell of HoFe2 was approximately four times larger than its chemical cell. Dissert. Abstr.

N70-39364# California Univ., Berkeley. Lawrence Radiation Lab.
INITIAL STAGES OF ORDERING IN Ni 4 Mo
Paul R. Okamoto (Ph.D. Thesis) Mar. 1970 123 p refs
(Contract W-7405-eng-48)
(UCRL-19175) Avail: NTIS

Transmission electron and field ion microscopy techniques were used to study the nature of short range order in as-quenched Ni4Mo and the changes which occurred during the very initial stages of the transition to the long range ordered state. Field ion images of both as-quenched and alloys aged for very short times below 750 C showed a strong tendency for clustering of well defined groups of atoms about the (420) fcc poles. The effect was most pronounced in aged alloys where ordered regions were directly resolved in dark field electron micrographs. However, the effect was also observed in the alloys in which ordered regions were not directly resolved in transmission electron micrographs. The

unique orientation dependence of the distribution of the well defined groups of atoms was evidence that the disordered alloy consisted of tiny regions possessing a layered type of atomic arrangement in which the Mo concentration was varying on the (420) matrix planes. Author (NSA)

N70-39442*# International Harvester Co., San Diego, Calif. Solar Div.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS Quarterly Progress Report, 8 Jun.–8 Sep. 1970
M. J. Klein, C. Antonick, and A. G. Metcalfe Sep. 1970 27 p refs
(Contract NAS7-469)
(NASA-CR-113547; RDR-1534-17; Solar-R-P-6-2426-7) Avail: NTIS CSCL 11F

The effect of solutes on the creep strength of columbium is being studied to develop more creep resistant columbium-base alloys. Strength-temperature profiles were determined for binary columbium-base alloys containing 1.5 atomic percent rhenium, 5 atomic percent zirconium, and 2.5 atomic percent zirconium, hafnium, tungsten, rhenium, molybdenum, vanadium or tantalum. For these dilute alloys, hafnium and zirconium are the most effective strengtheners below 0.5–0.6 T sub M while tungsten and rhenium are most effective at higher temperatures. Author

N70-39517# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CAVITATIONAL AND HYDRO-ABRASIVE RESISTANCE OF METALS IN HYDROTURBINES
I. R. Kryanin 4 May 1970 51 p refs Transl. into ENGLISH from Russian Conf. Paper
(AD-708328; FTD-HC-23-358-69) Avail: NTIS CSCL 11/6

It is found that the basic cause of cavitational erosion is the high frequency separation of micro-volumes of fluid from the surface of a solid body. For steels subject to corrosion, prolonged corrosive activity of water considerably increases the intensity of cavitational damage. When corrosion is alternated with brief cavitational activity in the magnetostrictive vibrator, erosion of carbon and low-alloy steels is increased by several factors. The described method of testing in the magnetostrictive vibrator is recommended for laborstory testing of materials. Author (TAB)

N70-39669# Ceskoslovenska Akademie Ved, Roz. Ustav Jaderneho Vyzkumu.
EFFECTS OF CERTAIN METALLURGICAL FACTORS ON RADIATION SENSITIVITY OF Mn-Ni-Mo STEEL PRESSURE VESSEL A-2 [VLIV NEKTERYCH METTALURGICKYCH FAKTORU NA RADIACNI CITLIVOST Mn-Ni-Mo OCELI PRO TLAKOVOU NADOBU A-2]
J. Cervasek and V. Juricka Mar. 1970 57 p refs In CZECH
(UJV-2314-M) Avail: AEC Depository Libraries

The radiation sensitivity of four variants of Mn-Ni-Mo steel were compared. Among particular variants the differences were in chemical composition, kind of working, killing, and heat treatment. The radiation sensitivity was compared in view of the changes of mechanical properties, transition temperature, and ability to recover. The experiments showed not only different absolute changes but also relative ones in particular variants according to neutron dose. The comparison showed that at 10 to the 19th power n/cm squared (E > 1 MeV), the heat with higher content of C, Mn, Cr and killed with Nb, Zr, Al, V is less sensitive than the original heat killed with Nb, Ti, Al. The comparison also showed that steel in the normalized state has better qualities than quenched and tempered steel. Author (NSA)

N70-39687# Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
THE EFFECTS OF CHROMIUM CONTENT ON STRUCTURAL STABILITY OF LOW CARBON STEELS [DER EINFLUSS DES CHROMGEHALTES AUF DIE FORMAENDERUNGSFESTIGKEIT NIEDRIG GEKOHLTER STAEHLE]
Manfred Grothe (Ph.D. Thesis) 30 Sep. 1969 118 p refs In GERMAN
Avail: NTIS

Mechanical and physical properties of low carbon steels with a chromium content of up to 30 percent are evaluated in order to determine alloy metal effects on steel deformation behavior. Compression tests on samples at room temperatures and up to 1200 C established different deformation behavior at cold and hot forming; stability in cold forming is determined by the basic deformation and embrittlement resistence depending on activation energies of the more or less strongly bound interstitial atoms in the iron lattice. A decrease in deformation resistance during hot forming, after reaching a definite maximum, is interpreted as relaxation phase. Flow curves of steels with variable chromium contents show that increased chromium addition increases steel deformation resistance according to ferritic and austenitic phase combinations. Transl. by G.G.

N70-39688# Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
CONTRIBUTION TO THE EXPLANATION OF ONE STEP ETCHING REACTIONS AND TO THE DEVELOPMENT OF ALLOYS FOR ONE STEP ETCHABLE STEREOTYPE ZINC [BEITRAG ZUR KLAERUNG DER VORGAENGE BEI DER EINSTUFENAETZUNG UND ZUR LEGIERUNGSENTWICKLUNG VON EINSTUFENAETZFAEHIGEM KLISCHEEZINK]
Michael Kurek (Ph.D. Thesis) 13 Mar. 1969 125 p refs In GERMAN
Avail: NTIS

Radioactive tracings and ampere-voltage curve methods are used to determine oil adsorption phases on zinc surfaces. Correlations between adsorption and single step etching behavior show that the adsorption of particles from flank protecting media affects the etching process to an extent determined by the crystalline lattice structure; some alloy element structures increase the velocity of zinc decomposition and others decrease the process. It is concluded that the proper choice of alloying elements results in the desired one step etching behavior of stereotype zinc. Transl. by G

N70-39711# Army Foreign Science and Technology Center, Washington, D.C.
INVESTIGATION OF CORROSION BEHAVIOR OF V-93 ALLOY UNDER STRESS [ISSLEDOVANIE KORROZIONNOGO POVEDENIYA SPLAVA V-93 POD NAPRYAZHENIEM]
T. N. Smirnova et al 18 Feb. 1970 12 p refs Transl. into ENGLISH from Fiz.-Khim. Mekh. Mater. (Ukrain.), v. 5, no. 3, 1969 p 275–279
(AD-707679; FSTC-HT-23-277-70) Avail: NTIS CSCL 11/6

The corrosion behavior of V-93 alloy under stress is investigated as a function of such factors as heat treatment, degree of deformation, form of original blank and size of grains. The purpose of the work is to find out how these factors influence the corrosion disintegration of semi-finished products made of V-93 alloy. Author (TAB)

N70-39730# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.
WELDING PROBLEMS OF THICK-WALLED STRUCTURES OF Al-Si 1-Mg 0.5 ALLOY OPERATING AT INCREASED TEMPERATURES
P. Jicinsky 1970 12 p refs
(ZJE-71) Avail: AEC Depository Libraries

The example of the heavy water vessel for the first

Czechoslovak reactor manufactured of Al-1.0% Si-0.5% Mg alloy demonstrated the problems which were met in welds of heavy thickness semi-products of this alloy group hardenable by heat treatment. Some results of short as well as long term tests are shown, the mechanical properties stability at various states of heat treatment is briefly dealt with and the effect of test specimen size on the measured mechanical properties of the structural material under investigation is mentioned. Author (NSA)

N70-39740# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

THERMODYNAMICAL ACTIVITY OF CALCIUM IN LIQUID Sn-Ca AND Be-Ca ALLOYS [ACTIVITE THERMODYNAMIQUE DU CALCIUM DANS LES ALLIAGES LIQUIDES SN-CA ET BE-CA]

C. Potard, B. Schaub, and P. Desre (Grenoble Univ., France) [1969] 11 p refs In FRENCH Presented at the 1st Intern. Conf. on Calorimetry and Thermodyn., Warsaw, 31 Aug.–4 Sep. 1969 (CEA-CONF-1503; CONF-690834-1) Avail: AEC Depository Libraries

The thermodynamic activity of calcium in beryllium dilute alloys at 1300 C was determined by a partition method between two immiscible liquid phases, Be-Ca and Sn-Ca. The calcium activity in the tin phase was determined at this temperature by the isopiestic method. Author (NSA)

N70-39749# California Univ., Livermore. Lawrence Radiation Lab.

ENGINEERING EVALUATION OF THE STATUS OF UTILIZATION OF BERYLLIUM FROM THE VIEWPOINT OF FRACTURE MECHANICS

P. C. Paris and D. O. Harris 28 Apr. 1970 34 p refs Presented Beryllium Conf., Arlington, Va., 23–25 Mar. 1970; sponsored by Natl. Mater. Advisory Board Submitted for publication Sponsored by AEC

(UCRL-72442; Conf-700311-1) Avail: NTIS

The inherent brittleness of beryllium makes it a prime candidate for the utilization of fracture mechanics information for design purposes. One obstacle to the more widespread use of fracture mechanics in the design of beryllium structures is the scarcity of information on its fracture toughness and subcritical flaw growth characteristics. A summary of the available data is presented, which indicates that Be does not compare favorably with other modern structural alloys on the basis of its static fracture properties. However, the limited amount of fatigue crack growth information available indicated that beryllium might have certain advantages in fatigue applications, and that proof testing provided a straightforward means of ensuring the integrity of cyclically loaded beryllium structures. More information on the fatigue crack growth characteristics of beryllium is required to verify this. Author (NSA)

N70-39750# Sandia Corp., Albuquerque, N.Mex. Measurement Development Div.

EFFECTS OF NEUTRON IRRADIATION AND HEATING ON THE DIMENSIONAL STABILITY OF STEEL WITH VARYING CHROMIUM CONTENT

Gilbert L. Eggert and Melvin R. Meyerson Apr. 1970 19 p refs Sponsored in part by AEC Prepared in cooperation with NBS, Washington, D.C.

(SC-RR-70-201) Avail: NTIS

A series of steel specimens in which the chromium content varied from 0.03 weight percent of 3.06 weight percent was prepared in the laboratory and made into the form of 1/4-inch, Grade AA gage blocks. The gage lengths were measured before being held at about 170 C for 115 hours both with and without neutron irradiation. The changes in gage length at five positions on the wringing surfaces of the blocks were measured after these treatments, which were intended to enhance the normally slow-phase transformations which affect volume and shape distortion. Although all the test gages contracted, the shape distortion was most severe in those compositions with less than 0.4 weight percent chromium, and minimal in gages with greater than 1.0 weight percent chromium. The cause of this behavior is explained. Author (NSA)

N70-39755# British Iron and Steel Research Association, London (England).

THE PREVENTION OF CORROSION IN STEEL BRIDGEWORKS

K. A. Chandler 1 Dec. 1969 12 p refs

(PB-190465; C/25/67) Avail: NTIS CSCL 13M

Methods of preventing the corrosion of steel in bridges are discussed. In particular, the corrosion-resistance of high strength steels, the choice of protective coatings and the influence of design are considered. Author (USGRDR)

N70-39761# British Steel Corp., London (England). Metallurgy Div.

THE STRUCTURE AND PROPERTIES OF SOME DIRECT QUENCHED AND TEMPERED 1 INCH THICK PLATES

G. Tither and J. Kewell 1970 17 p refs

(PB-191971; MG/C/92/69) Avail: NTIS CSCL 11F

The microstructures and mechanical properties of some quenched and tempered niobium and vanadium-nitrogen steels are reported. The properties were produced in laboratory trials on 1/2 in. thick plate which was quenched to simulate the cooling of 1 in. thick plate using the BISRA quenching rig. The plates were water quenched directly after controlled rolling to 950 C and subsequently tempered in the temperature range 600 to 675 C for 1 hour. The effect of quenching rate is also described. It has been possible to produce yield strengths up to 77.0 hbar (50.0 tonf/sq in) with adequate toughness in simulated 1 in. plate. Author (USGRDR)

N70-39776# Naval Research Lab., Washington, D.C. Physical Metallurgy Branch.

CORROSION FATIGUE CRACK GROWTH BEHAVIOR ABOVE AND BELOW K SUB Iscc Final Report

J. P. Gallagher 28 May 1970 23 p refs

(AD-708377; NRL-7064) Avail: NTIS CSCL 11/6

The purpose of this investigation was to contrast the salt water corrosion fatigue crack propagation behaviors observed in the two regimes of no measurable sustained load crack propagation and of measurable stress-corrosion cracking rates. A typical structural steel, HY-80 steel, having intermediate strength and high toughness, was selected for its high resistance to environmental cracking under sustained load. A high-strength 4340 steel which was previously shown to be highly susceptible to environmental cracking under sustained loads was chosen for the study. Author (TAB)

N70-39815# Commissariat a l'Energie Atomique, Grenoble (France). Dept. de Metallurgie.

THERMODYNAMIC STUDY OF Be-Al SYSTEM [ETUDE THERMODYNAMIQUE DU SYSTEME BERYLLIUM-ALUMINIUM]

Bernard Schaub, Claude Potard, and Pierre Desre [1969] 8 p refs In FRENCH Presented at the 1st Intern. Conf. on Calorimetry and Thermodyn., Warsaw, 31 Aug.–4 Sep. 1969 (CEA-CONF-1502; CONF-690834-2) Avail: AEC Depository Libraries

The thermodynamic properties of Be–Al alloys were studied at 1600 K over the whole range of concentration. The thermodynamic activities and the partial molar enthalpies were estimated and verified by some measurements made with the Knudsen effusion method. Author (NSA)

N70-39819# British Steel Corp., London (England).
SOME METALLURGICAL ASPECTS OF QUENCHED AND TEMPERED PRESSURE VESSEL STEELS
K. H. Lewis, R. F. Johnson, and K. A. Ridal 1970 17 p
(PB-191970; M(E)61/69C) Avail: NTIS CSCL 11F

Recent advances in design techniques and in the production of high strength quenched and tempered steels have led to the wider application of these steels in pressure vessel technology. The metallurgical factors governing the properties of quenched and tempered steels are briefly discussed and certain aspects of the production of steels for both forged and fabricated vessels are considered. Author (USGRDR)

N70-39865# Naval Civil Engineering Lab., Port Hueneme, Calif.
RELATIONSHIP BETWEEN MARINE FOULING AND CORROSION RATE OF CARBON STEEL AND ALUMINUM ALLOY AT THE SURFACE AND AT 6,000-FOOT DEPTH
J. S. Muraoka May 1970 57 p refs
(AD-708012; NCEL-TR-681) Avail: NTIS CSCL 11/6

Carbon steel (1010) and aluminum alloy (7178-T6) panels were exposed at the surface (23 to 286 days) and at 6,000-foot depth (189 days) in the Pacific Ocean (1) to determine the effects of fouling organisms on the corrosion rate and (2) to compare the biological corrosion rate of identical test panels submerged at the two depths. Seawater samples obtained at the surface and at depth were analyzed for dissolved oxygen concentration, pH, salinity and temperature. Bacteriological tests were also conducted on seawater samples. The test panels were submerged in the sea as follows to obtain data on corrosion rates: (1) enclosed inside an initially sterile plastic cylindrical chamber with both ends sealed with membrane filters (control panels), (2) placed inside a cylinder covered with 210-mesh nylon screen cloth, (3) placed inside a cylinder with both ends uncovered, and (4) attached to a phenolic plastic strip (exposed panels). The control specimens became contaminated; however, from corrosion data obtained on test panels exposed on the seafloor in 6,000 feet of water, it is concluded that slime films played a significant role in accelerating corrosion of test specimens. Test panels exposed at the surface corroded at faster rates than replicate test panels which were exposed on the seafloor in 6,000 feet of water. The corrosion rates of both steel and aluminum alloy panels approach constancy after extended exposure in the sea. The various environmental factors and their effects on the corrosion rates at the surface of the sea and at great depth on the seafloor are discussed. Author (TAB)

N70-39894# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
MAGNETIC CORE ALLOYS FOR CURRENT TRANSFORMERS: A COMPARISON OF SATURATION CHARACTERISTICS
J. C. Roubik and J. R. Smith 26 Feb. 1970 16 p
(Contract AT(29-2)-656)
(GEPP-79) Avail: NTIS

Tests were run to determine saturation characteristics of seven different magnetic core alloys for current transformers. The seven alloys tested were: Deltamax, Square Permalloy, Silectron, Mo-Permalloy(4-79), Supermendur, Supermalloy, and 2V Permendur. Saturation characteristics of these various alloys were compared with one-mil Mo-Permalloy(4-79). Test results indicated that 2V Permendur saturates at more than twice the ampere/microsecond level than the Mo-Permalloy(4-79) reference core. Author

N70-39918# Naval Postgraduate School, Monterey, Calif.
FATIGUE TESTING OF 70-30 COPPER-NICKEL
Gary Lee Rowe (M.S. Thesis) Dec. 1969 71 p refs
(AD-708384) Avail: NTIS CSCL 11/6

An investigation is made of the feasibility of the use of the S/N Fatigue Life Gage as a monitoring device for cumulative fatigue damage in 70-30 copper-nickel. The study is aimed at verifying the hypothesis that the permanent change in resistance experienced by such a gage when bonded to a structure subjected to varying load conditions is a function of the strain history of the underlying material, and that the total resistance change in the gage at the time of crack initiation in the structure is essentially constant, independent of strain level or history. In particular, because of its importance in naval applications, the material for which this hypothesis has been examined in this study is 70-30 copper-nickel. The hypothesis is sufficiently well verified to justify recommending testing at additional strain levels, and evaluating the effects of block-cycling, aging and other influences likely to be encountered in in-service monitoring of fatigue damage. Author (TAB)

N70-40009# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
SULFIDE INCLUSIONS IN STEEL Interim Report, 1 Jan. 1968 – 31 Dec. 1969
L. K. Bigelow and M. C. Flemings Mar. 1970 235 p refs
(Contract DAAG46-68-C-0043)
(AD-707952; AMMRC-CR-70-13) Avail: NTIS CSCL 11/6

The formation of sulfide inclusions in the Fe-Mn-S system was studied using high purity materials. Modifications of this basic system by controlled additions of oxygen aluminum, carbon, and silicon were made in order to study the factors causing the various inclusion morphologies observed in commercial alloys. The effect of cooling rate on inclusion morphology was studied over the range of 0.5C/sec to greater than 100C/sec. Author (TAB)

N70-40024# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF PERFORATION MECHANICS IN THIN ALUMINUM PLATES
Richard David Gabbert (M.S. Thesis) Jun. 1970 78 p refs
(AD-707837; GAW/MC/70-2) Avail: NTIS CSCL 11/6

The Nishiwaki theory of penetration was investigated for seven projectile shapes against three thicknesses of 6061-T6 aluminum target material. The projectiles were fired from a 50 caliber gun at impact velocities near 500 m/sec. Initial velocities and projectile velocity losses were measured by flash x-rays and chronographs. The same projectile shapes were also used to perforate identical targets quasi-statically with a laboratory universal testing machine. This provided the empirical information necessary to the application of the Nishiwaki theory. The basic Nishiwaki equations were found to be inaccurate for most projectile shapes. A modification of this theory was investigated and found to be accurate in predicting projectile velocity losses to within 6 m/sec at impact velocities near 500 m/sec. Additional proposed penetration models are presented but not investigated. Author (TAB)

N70-40040# Naval Research Lab., Washington, D.C.
DYNAMIC TEAR TEST INVESTIGATIONS OF THE FRACTURE TOUGHNESS OF THICK-SECTION STEEL Final Summary Report
F. J. Loss 14 May 1970 56 p refs
(AD-707711; NRL-7056; HSSTP-TR-7) Avail: NTIS CSCL 11/6

The effect of mechanical constraint imposed by thick sections is examined in the framework of linear elastic fracture mechanics (LEFM) and other temperature-transition indices. Extrapolation of thin-section LEFM data to higher temperatures has raised the concern that thick-section steels, of shelf toughness and strength class similar to A533-B, will not exhibit a brittle-to-ductile transition with increasing temperature. Research programs relating to thick dynamic tear (DT) test studies and those relating to thick LEFM investigations have shown that unirradiated A533-B does exhibit a significant increase in toughness within a relatively narrow temperature region near the nil ductility transition (NDT) temperature. Size effects studies indicate that the effects of mechanical constraint associated with thick sections elevate the fracture transition--elastic

(FTE) temperature (the temperature at which very large flaws remain dormant up to yield stress) for 12-in.-thick sections approximately 70F (39C) above the FTE temperature for thin sections, which in turn is 60F (33C) above the NDT temperature. Author (TAB)

N70-40092# Lockheed-Georgia Co., Marietta. Materials Research and Development Lab.
MECHANISM OF SUPERPLASTICITY IN Al-78% Zn ALLOY Technical Report, 20 Jun. 1969—20 Jun. 1970
Ervin E. Underwood, Enu U. Lee, and Harvard H. Kranzlein 20 Jun. 1970 34 p refs
(Contract N00014-67-C-0503)
(AD-707740; TR-3) Avail: NTIS CSCL 11/6

Activation energies were obtained for dynamic recovery and for tensile deformation. The values for deformation are delta H sub d = 22.5 plus or minus 3.5 kcal/mol (at low temperatures) and delta H sub d = 37.5 plus or minus 2.5 kcal/mol (at high temperatures). These two activation energies are related to the rate-controlling processes of cross-slip and dislocation climb, respectively. Thus, the activation energy for dynamic recovery, delta H sub r = 22 kcal/mol, corresponds to the cross-slip of screw dislocations, which leads to the formation of stable dislocation networks and dislocation-free sub-grains. At higher deformation temperatures, dislocation climb predominates, and subboundary disintegration and coalescence of subgrains are observed. Dislocation loops have been reported mostly in fcc metals and alloys after quenching from elevated temperatures and subsequent aging. This paper reports the formation and characteristics of dislocation loops in the hcp Zn-0.7%Al alloy resulting from quenching and aging. Author (TAB)

N70-40117# Aerospace Corp., El Segundo, Calif. Lab. Operations.
THE INFILTRATION OF GRAPHITE YARN WITH ALUMINUM ALLOYS, JANUARY—JUNE 1969
Roger T. Pepper, E. George Kendall, and Louis Raymond 1 Mar. 1970 17 p
(Contract F04701-69-C-0066)
(AD-707840; TR-0066(9250-03)-2; SAMSO-TR-70-194) Avail: NTIS CSCL 11/4

The potential of the aluminum-graphite composite as a high strength to density and high modulus to density structural material is described, and a process for the infiltration of commercially available graphite yarns with aluminum alloys is mentioned. The microstructure of the infiltrated yarn shows that complete infiltration of the bundles of 7-microns-diam fibers by the aluminum alloy occurs during the infiltration process. Tensile tests show that the mechanical properties of the fibers are not degraded during infiltration with aluminum. Microexamination of the matrix-fiber interface shows that no significant interaction layer is present and indicates that a strong bond exists at the interface. Author (TAB)

N70-40197# Defense Documentation Center, Alexandria, Va.
EMBRITTLEMENT, VOLUME 1 A DDC Bibliography
Jun. 1970 96 p refs
(AD-708700; DDC-TAS-70-51-1) Avail: NTIS CSCL 11/6

The annotated bibliography is a compilation of unclassified and unlimited reports on embrittlement. Corporate author-monitoring agency, subject, and contract number indexes are provided. Author (TAB)

N70-40244# Army Materials and Mechanics Research Center, Watertown, Mass. Metals Div.
HEAT TREATMENT EFFECTS ON THE MECHANICAL PROPERTIES AND PHASE TRANSFORMATIONS IN Ti-6Al-6V-2Sn
Charles F. Hickey, Jr. and Paul J. Fopiano Feb. 1970 16 p refs
(AD-707930; AMMRC-TR-70-4) Avail: NTIS CSCL 11/6

The effect of phase transformations on the mechanical properties (including fracture toughness) of the titanium alloy Ti-6Al-6V-2Sn has been investigated for various heat-treated conditions. Based upon a preliminary hardness survey of solution temperatures from 1300 to 1800 F, solution treatment temperatures of 1400, 1550, and 1700 F were selected for further aging heat treatments ranging from 700 to 1100 F for times up to 32 hours. X-ray and electron microscopic observations and elastic modulus determinations were employed and correlated the mechanical property data. A detailed discussion of the results and observations is contained in the paper. Author (TAB)

N70-40277# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ON THE MODALITY OF FATIGUE ENDURANCE DISTRIBUTIONS IN OFHC COPPER
G. K. Korbacher Jun. 1970 70 p refs
(AD-708825; UTIAS-145) Avail: NTIS CSCL 11/6

Altogether 884 OFHC copper specimens were fatigued under axial-load of 10, 12.7, 13, 14, 16.5 and 19 ksi constant amplitude and zero mean stress. Log-normal, extreme value, combinations of two truncated log-normal and truncated log-normal and extreme value distribution functions were fitted to the experimental endurance distributions. Furthermore, a mathematical dissection method was applied. The main results of this study are: the two endurance distributions observed with alloys could not be verified by polycrystalline (OFHC) copper; at stress levels around the lower knee the existence of two modes (bimodality) was apparent; at stress levels well above the knee, endurance distributions seem to become single log-normal, below the knee, extremal; the bimodality seems to be caused by a transition of predominance from one to another fatigue mechanism (Woods F to H range transition). In conclusion, it may be said that the most important factor responsible for either the single, bimodal or two endurance distribution phenomenon seems to be the microstructural response of the tested material to the acting stress level. Author (TAB)

N70-40281# Naval Postgraduate School, Monterey, Calif.
FATIGUE MONITORING OF 70-30 COPPER-NICKEL
Franklin Bruce Lash (M.S. Thesis) Jun. 1970 45 p refs
(AD-709090) Avail: NTIS CSCL 11/6

Recent tests by G. L. Rowe indicated the possibility of monitoring faitgue damage of 70-30 copper-nickel by use of a commercial fatigue life gage. The work reported herein, however, which includes tests at cyclic strain levels considerably higher and lower than those used by Rowe, suggests that much more study and development will be required before in-service monitoring will be careful or reliable. Fatigue failure, using initial surface crack formation as a criterion, takes place at low cyclic strain levels with appreciably smaller gage indication than does failure at medium or high cyclic strain levels. It is further noted that ability to detect surface cracks depends greatly upon the expertise of the observer so that a less subjective criterion of failure should be developed. Author (TAB)

N70-40325# Aerojet-General Corp., Sacramento, Calif. Materials Research Lab.
PHASE EQUILIBRIA INVESTIGATION OF BINARY, TERNARY, AND HIGHER ORDER SYSTEMS. PART 6: THE PHASE EQUILIBRIA IN THE METAL-RICH REGION OF THE HAFNIUM-TANTALUM-NITROGEN SYSTEM
Philip H. Booker and Charles E. Brukl Dec. 1969 90 p refs
(Contract F33615-67-C-1513)
(AD-700985; AFML-TR-69-117-Pt-6) Avail: NTIS CSCL 11/6

The ternary alloy system tantalum-hafnium-nitrogen was investigated by means of melting point, X-ray, differential thermal analytical, and metallographic techniques. Also investigated were the two binary systems of tantalum-nitrogen and hafnium-nitrogen. In the ternary system, seven isothermal reactions occur: Three, Class II-type four-phase reactions and four limiting tie line reactions are observed. The observed phase relationships established during

the course of this investigation are discussed, and isothermal sections from 1000C to 3200C as well as an isometric view of the ternary system are presented. In addition to the ternary system, phase diagrams for the two binary systems of tantalum-nitrogen and hafnium-nitrogen are also presented. Author (TAB)

N70-40377# Ghent Univ. (Belgium).
LABORATORY FOR STRENGTH OF MATERIALS Progress Report, 30 Sep. – 30 Dec. 1969
30 Dec. 1969 6 p
(Contract EURATOM-081-67-1-TEEC(RD))
(EURAEC-2138; EUR-4028) Avail: NTIS

Four Robertson tests were carried out on Types 5 RD 81, 6 RD 81, 9 RD 81, and 10 RD 81 steel specimens at 63 or 100 mm thickness. The crack arrest temperature for certain conditions of thickness and stress is estimated. NSA

N70-40379# Brookhaven National Lab., Upton, N.Y.
DETERMINATION OF METALLIC AND NON-METALLIC TRACE IMPURITIES IN SODIUM METAL
Clemens Auerbach, ed. Jan. 1970 54 p refs
(BNL-50229) Avail: NTIS

The methods used currently at Brookhaven National Laboratory for the determination of trace impurities in sodium metal are reported. Procedures are given for nonmetallic (oxygen, hydrogen, total carbon, carbonate carbon) and metallic (copper, chromium, manganese, cobalt, nickel, iron) impurities. In addition, methods are described for the following: (a) determination of trace nitrogen, carbon, and oxygen in vanadium-titanium-chromium alloys, which are being evaluated as container materials, and (b) determination of the composition of thoria-yttria ceramics, which are used as the solid electrolyte in oxygen meters. Author (NSA)

N70-40394# Massachusetts Inst. of Tech., Cambridge.
THE EFFECT OF GRAIN SIZE ON FATIGUE: THE FRACTURE OF DUCTILE METALS
Walter A. Backofen and Anthony W. Thompson Jun. 1970 74 p refs
(Contract N00014-67-A-0204-0015)
(AD-707752) Avail: NTIS CSCL 11/6

Fatigue at long lives was studied in materials of different grain sizes. Alpha brass, copper and aluminum were tested in tension-compression at constant stress-amplitude over a life range of 1000 to 10,000,000 cycles. Grain size, d, was varied by at least a factor of ten, and beyond 100,000 cycles had no effect on life in copper and aluminum. In brass, however, an order of magnitude decrease in d increased life by about the same amount. The stress for a given life, theta, was found to be proportional to d to the minus 1/2 power in brass. Cracks were examined in longitudinal sections, and the average crack depth, was proportional to d in brass. That dependence was the basis for concluding that the grain-size effect came from Stage 1 cracking. The differences in behavior between brass and copper and aluminum were traced to the differences in slip character of these materials. Cross-slip is easy in copper and aluminum, and a dislocation cell structure is formed in fatigue. In brass, difficult cross-slip limits the structure to transgranular bands of dislocations. The cell structure acts to mask the grain boundaries, so that the Stage 1 crack is not affected by grain size. In brass, however, crack growth is impeded near grain boundaries. Increasing grain size in brass lowers the frequency with which the crack encounters boundaries; more rapid Stage 1 crack growth and shortened life follow from this. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N70-39090# Los Alamos Scientific Lab., N.Mex.
EFFICIENCY OF IPC-1478 FILTER PAPER AGAINST POLYSTYRENE LATEX AND DIOCTYL PHTHALATE AEROSOLS
Ronald G. Stafford and Harry J. Ettinger Dec. 1969 11 p refs
(Contract W-7405-eng-36)
(LA-4356) Avail: NTIS

IPC-1478 filter paper efficiency was evaluated using polystyrene latex and dioctyl phthalate (DOP) aerosols. Efficiency was measured as a function of particle size, filtration velocity, and filter mass loading. Experimental results for 0.557 μm and larger particle sizes indicate that this medium has limited effectiveness under high-velocity and high-loading conditions. Differences in efficiency were observed when this medium was tested with solid and liquid aerosols. NSA

N70-39136 Stanford Univ., Calif.
THE FIXATION OF PHOTOELASTIC STRESS PATTERNS BY ELECTRON IRRADIATION AND ITS APPLICATION OF THREE-DIMENSIONAL PHOTOELASTICITY
Robert Francis Sullivan (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-17456

A technique in photoelasticity was developed using electron bombardment to fix photoelastic stress patterns in a loaded epoxy model. The epoxy resin is cast with less than the standard amount of hardener. This limits the molecular weight of the material and, when cured, produces a rigid solid whose degree of polymerization has not achieved its maximum value. Upon loading, the original polymer structure is deformed elastically to form a photoelastic stress pattern. Ionization takes place within the polymer material when the model is bombarded with high energy electrons leading to the creation within the material of new primary bonds, particularly cross-links between existing polymer chains. The new primary bonds increase the molecular weight of the material and create a new and unstressed three-dimensional polymer structure. This new polymer structure restrains recovery of the original polymer structure when the load is removed, thereby fixing the photoelastic stress pattern and mechanical deformation in the model. Dissert. Abstr.

N70-39157# Los Alamos Scientific Lab., N.Mex.
COMPARISON OF FILTER MEDIA AGAINST LIQUID AND SOLID AEROSOLS
Ronald G. Stafford and Harry J. Ettinger May 1970 8 p refs
(Contract W-7405-eng-36)
(LA-4345) Avail: NTIS

Several filter media were evaluated using liquid (0.3 micron DOP) and solid (approximately 0.3 micron polystyrene latex) test aerosols. Data were obtained for each medium at velocities ranging from 4 to 190 ft/min. Below 100 ft/min, Whitman-41 filter paper has a significantly higher efficiency when tested with solid aerosols. Below 40 ft/min, IPC-1478 also has a significantly higher efficiency when tested with solid aerosols. Instrumentation limitations prevented measuring any significant differences for the high efficiency media tested. Aerosol agglomeration and charge effects were eliminated by using an impactor and by establishing charge equilibrium for the solid aerosols. Average electron charge on latex particles was reduced to 0.5, and the test aerosol consisted of 87 to 97% single particles. The effects of filter loading on efficiency and pressure drop was also measured. Whatman-41 efficiency was significantly increased due to loading with polystyrene latex aerosols. This did not occur with DOP. Author

N70-39179# Bendix Corp., Kansas City, Mo.
BONDING STRENGTH OF ENCAPSULATING MATERIALS TO HOOKUP WIRES

Rolf R. Crockett Jun. 1969 45 p
(Contract AT(29-1)-613)
(BDX-613-135) Avail: NTIS

Knowledge of the effect of rigorous conditioning on the bond strengths between encapsulating materials and insulated wire is necessary for the fabrication of encapsulated, insulated hookup wire for cable assemblies in weapon applications. Data of the effectiveness of bonds between two encapsulating systems and six types of insulated wire following temperature, thermal and mechanical shock, heat aging, ozone, humidity, and composite environment conditionings are presented. Information on best bonds obtained is included in the conclusions. Data, presented both in tabular and graphic form, and illustrations are included. Author (NSA)

N70-39274# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
DISCONTINUOUS CARBON-CARBON COMPOSITE FABRICATION
J. L. Cook, F. Lambdin, and P. E. Trent 20 May 1970 40 p refs
(Contract W-7405-eng-26)
(Y-1719) Avail: NTIS

Composites consisting of short fibers in a carbon or graphite matrix were fabricated by isotropic casting, flock lay up, spray lay up, and pulp molding. Models of the fiber structures generated by each technique were considered and related to the physical and mechanical properties and processing characteristics. For hollow cylinders, the structural integrity and the rate of densification by repeated liquid resin impregnation, carbonization, and graphitization were influenced by the anisotropic behavior of the fiber structures. Selected properties of the materials resulting from these fabrication techniques were determined. Author (NSA)

N70-39383# Gulf General Atomic, San Diego, Calif.
EFFECT OF THE TEMPERATURE HISTORY ON THE DIMENSIONAL CHANGES OF NUCLEAR GRAPHITES
G. B. Eagle 23 Mar. 1970 14 p refs
(Contract AT(04-3)-167)
(GA-10001) Avail: NTIS

When anisotropic needle-core graphites and near-isotropic graphites were irradiated initially to approqimately 3 × 10 to the 21st power n/sq cm at approximately 1000 C and then to higher fluences at 760 to 800 C, the rate of dimensional change did not adjust to the slower rate expected for the lower temperature. When the initial irradiation was done at 1450 C to approximately 3 × 10 to the 21st power n/sq cm and was followed by irradiation at 1225 to 1250 C to 9 × 10 to the 21st power n/sq cm, the dimensional change rate was higher than that for specimens irradiated to 9 × 10 to the 21st power n/sq cm entirely at 1225 to 1250 C. Author (NSA)

N70-39368# Massachusetts Inst. of Tech., Cambridge. Ceramics Div.
BASIC RESEARCH IN CRYSTALLINE AND NONCRYSTALLINE CERAMIC SYSTEMS Annual Report
W. D. Kingery and R. L. Coble Apr. 1970 21 p refs
(Contract AT(30-1)-3773)
(MIT-3773-84) Avail: NTIS

Research on fluorite structure materials, on nonstoichiometric compounds, and on solid solution oxides are reported. Results are included from investigations of phase changes, diffusion, and ceramic microstructure. Other investigations were concerned with relations of properties with composition, crystal structure, and microstructure. Research is also reported on structure and properties of thin films and noncrystalline solids. NSA

N70-39404*# Dartmouth Coll., Hanover, N.H.
PHYSICAL AND CHEMICAL PROPERTIES OF THIN POLYMER FILMS Final Report, Oct. 1968—Jan. 1970
Robert W. Christy and Laurence E. Babcock *In* TRW Systems Group Advanced Spacecraft Valve Technol. Jul. 1970 36 p refs (See N70-39401 22-15)
Avail: NTIS CSCL 11I

The electronic structure of thin polymer films which are formed on a substrate by electron bombardment in the presence of molecules of an organic or silicone vapor was investigated. Under suitable conditions of formation these films are extremely resistant to mechanical abrasion and chemical attack, and are therefore promising as a protective coating for other materials, as in the application to valve technology. The films are formed by the free-radical polymerization of the molecules adsorbed on the surface, under the action of the bombarding electrons. The molecules are cross-linked by the electron beam to form a solid polymer film. The The molecules used were DC 704 (Dow-Corning), a tetramethyl tetraphenyl trisiloxane. In the limit of large electron/molecule ratios during the formation of the film, the resulting structure could be similar to silicon monoxide with the incorporation of some organic radicals, assuming that a large fraction of the original organic radicals would be detached by the electron bombardment. The analysis of the films is from the standpoint of band theory of inorganic semi-conductors rather than that of organic molecular crystals. Author

N70-39487# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
ON GAMMA RAY INDUCED CHANGES IN RHEOLOGICAL BEHAVIOR AND MICROSTRUCTURE OF STRETCHED LINEAR HIGH POLYMERS [UEBER GAMMASTRAHLENINDUZIERTE AENDERUNGEN DES RHEOLOGISCHEN VERHALTENS UND DER MIKROSTRUKTUR VERSTRECKTER LINEARER HOCHPOLYMERER]
Hubert Reiter (Ph.D. Thesis) 1969 136 p refs In GERMAN
Avail: NTIS

Gamma irradiation effects on mechanical and melting properties of Perlon and Dralon fibers were determined by analyzing various points on their visco-elastic stretching curve in relation to applied tension and radiation dosage and by observing melting phase transformation changes. Results show that an increased radiation dosage also increases deformation or destroys regions that were not deformed by stretching in both fibers. Perlon melting phase also shifts to lower values with increased gamma radiation dosage. Transl. by G.G.

N70-39638# Advisory Group for Aerospace Research and Development, Paris (France.)
FUELS, LUBRICANTS, AND AUXILIARY FLUIDS FOR SUPERSONIC AND HYPERSONIC AVIATION [COMBUSTIBLES, LUBRIFIANTS ET FLUIDES AUXILIARES POUR AVIATION SUPERSONIQUE ET HYPERSONIQUE]
Jun. 1970 334 p refs In FRENCH; ENGLISH summary
(AGARDograph-108; AGARD-AG-108-70) Avail: NTIS

CONTENTS:

1. FUELS POSED BY HIGH SPEED FLIGHTS J. Ducarme (Liege Univ., Belgium) p 1—28 refs (See N70-39639 22-02)

2. FUELS FOR SUPERSONIC AIRCRAFT T. de Menten de Horne (Labofina Soc. Anonyme, Brussels) p 29—50 refs (See N70-39640 22-27)

3. LUBRICANTS AND HYDRAULIC FLUIDS G. J. Souillard (Labofina Soc. Anonyme, Brussels) p 51—71 refs (See N70-39641 22-18)

N70-39641# Labofina Societe Anonyme, Brussels (Belgium).
LUBRICANTS AND HYDRAULIC FLUIDS . [LUBRIFIANTS ET FLUIDES HYDRAULIQUES]
Georges J. Souillard *In* AGARD Fuels, Lubricants, and Auxiliary Fluids for Supersonic and Hypersonic Aviation Jun. 1970

p 51–71 refs In FRENCH (See N70-39638 22-19)
Avail: NTIS

Lubrication oils and systems for supersonic and hypersonic turbine engines are discussed, along with hydraulic fluids and systems, with relation to function and classification. Principal factors of influence are related, including density, viscosity, thermal degradation and oxidation of the oils and fluids, hydrolysis effects, lubricating properties, hydraulic fluid compressibility, fire resistance, and tendency to foam. Possible choices of oils and fluids are suggested for both present and future applications. Base products for lubricant oils and hydraulic fluids are then considered. The influence of the chemical structure on physiochemical properties is examined. The properties and preparation of hydrocarbons, esters and polyesters in general, phosphoric esters, organic halogen derivatives, organic derivatives of silicon, polyphenyl ethers, and other chemical derivatives are discussed. Antioxidation additives for oils operating at elevated temperatures are described, along with additives to protect against rust, corrosion, wear and extreme pressure. Lubricating greases, solid lubricants, and lubrication by molten metals and salts and by gas are also considered. Bibliographies are included. Transl. by P.A.B.

N70-39696# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OXYALKYLATED AMINO COMPOUNDS AS LUBRICANTS
N. M. Nikolaeva et al 1 Apr. 1970 9 p refs Transl. into ENGLISH from Neftepererabotka i Neftekhim., Nauchn.-Tekhn. Sb. (Moscow), no. 3, 1969 p 18–20
(AD-708324; FTD-HT-23-202-70) Avail: NTIS CSCL 11/8

By the successive joining of ethylene oxide and propylene oxide to ethylenediamine and monoethanolamine, several block copolymer were synthesized. Their evaporability in a thin layer, oxidation stability, viscosity-temperature properties, performance in conditions of friction and rocking (using a 5-ball mill), and antiwear properties (in a 4-ball mill) were studied. TAB

N70-39767*# Aerojet-General Corp., Sacramento, Calif. Nuclear Div.
BEARING RETAINER MATERIALS DEVELOPMENT Final Report
P. Dessau Oct. 1969 76 p refs
(Contract SNP-1)
(NASA-CR-113158; RN-S-0534) Avail: NTIS CSCL 11D

During the period January to June 1969, a series of 50-mm bearing tests were performed in liquid hydrogen with irradiated and unirradiated ball- and roller-bearing retainers fabricated from experimental materials. Several of these materials had been qualified by low- and high-speed wear tests, the results of which were reported in earlier reports. Results of testing during the current period, in addition to the results of testing of five parts previously reported, indicate that the major objective of the program to develop radiation-resistant retainer materials has been successfully achieved. Results of irradiation and bearing test performance are described. Several new, irradiated, reinforced polymers were tested. Of these, the PBI-glass material performed successfully in every respect, qualifying both the material and an improved retainer configuration. The PBI-graphite roller retainers performed satisfactorily. Correlation between retainer wear rate and wear-test wear rate was demonstrated. NSA

N70-39781# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Chemistry and Chemical Engineering.
CRYSTALLIZATION STUDIES ON DEFORMED POLYBUTENE-1 MELTS
Anthony Wereta, Jr. and Costas G. Gogos Jun. 1970 37 p refs
(Contract N00014-68-A-0131)
(AD-708056; TR-15) Avail: NTIS CSCL 11/9

An apparatus was designed and built which allowed an investigation concerning the morphology and kinetics of crystallization of a deformed polybutene-1 melt. The polymer was quenched from a temperature above its melting point to one of two crystallization temperatures. The supercooled melt was then sheared and allowed to crystallize isothermally while the internal stress in the melt was continuously recorded. A polarizing microscope was employed for the simultaneous study of the resulting morphological changes. By properly accounting for thermal contractions within the apparatus caused by the quenching operation, as well as the imposed shear strain, a strain history of the polymer during crystallization was developed. From this strain history and the assumption that the volume contraction resulting from crystallization was isotropic, approximate kinetics of crystallization in a deformed polymer melt were determined. Author (TAB)

N70-39897* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS LUBRICANT COMPOSITIONS Patent
Donald H. Buckley and Robert L. Johnson, inventors (to NASA) Issued 8 Jan. 1963 (Filed 27 Oct. 1960) 3 p Cl. 252-58
(NASA-Case-XLE-00353; US-Patent-3,072,574;
US-Patent-Appl-SN-65548) Avail: US Patent Office CSCL 11H

High temperature lubricants which minimize corroeive wear and form reaction films with desirable lubricating properties are described. The lubricants consist of a gas mixture of CF2Br2 and CF3Br, and a 1:1 blend was found to provide a synergistic effect, superior to a 2:3 or a 3:2 ratio. The test methods and results are also given. N.E.N.

N70-39947# Lockheed Missiles and Space Co., Palo Alto, Calif. Lockheed Research Lab.
LMSC GLASS-LIKE CARBON. GLASS-LIKE CARBONS TAILORED FOR SPECIFIC REQUIREMENTS, STANDARD GLASSY CARBON-GRADES 2000 AND 3000, HIGH-STRENGTH GLASSY CARBON-GRADES 2000 AND 3000, HIGH-CONDUCTIVITY GLASSY CARBON-GRADE 2500
Aug. 1969 18 p refs
(AD-708314; LMSC-6-78-69-33) Avail: NTIS CSCL 11/2

LMSC Glass-Like Carbon is one of the newer forms of hard, impervious, and nongraphitizing-type carbons. It is a monolithic form of carbon produced from the degradation of an organic polymer. The precursor polymer employed can be modified substantially to produce variations in the carbon structure. The carbon and use is analyzed to determine the best precursor resin. The property similarities between this material and glass are high tensile strength, high compressive strength, low permeability, isotropic characteristics, and low impact strength. However, since the material is a pure carbon, the high-temperature properties are substantially higher than those of glass. Tensile strength at 2500C is double the room temperature values. Preliminary studies indicate long-term stability at 1000F in air. As a new high-temperature structural material and an improved carbon product, LMSC Glass-Like Carbon offers many advantages. Current applications include high-temperature reaction vessels, crucibles, resistance elements, induction susceptors, and electrodes. Author (TAB)

N70-40030# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF DISPERSION MEDIUM VISCOSITY ON THE BASIC CHARACTERISTICS OF LITHIUM LUBRICANTS
V. V. Sinitsyn et al 15 Apr. 1970 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii Neft i Gaz (Baku), v. 12, no. 3, 1969 p 58–62
(AD-708332; FTD-HT-23-200-70) Avail: NTIS CSCL 11/8

Lubricants with dispersion media of various viscosities were prepared with arctic diesel fuel and aviation oil MK-22. A great variation of the dispersion medium viscosity had a small effect on the crystal size and form of the Li soap. By increasing the viscosity of the medium from 4 to 30 cp. at 20 degrees and then from 250

to 1600 cp. at 20 degrees, first a decrease and then an increase of the soap filament size was obtained in lubricants thickened with Li stearate. The colloidal stability of the lubricants was improved when the viscosity of the medium increased. The improving rate of the colloidal stability decreased with oil of viscosity 30-50 centistokes. The shearing and breaking strength increased and then decreased according to the variation of their structure, the max. being for oils with 30-50 centistokes viscosity. The effective viscosity at 20 degrees of lubricants and shearing rates 10-1000/sec increased and then remained const. when the dispersion medium had a viscosity of 4-30 cp. The origin and compn. of the oil had a small effect on the structure and properties of Li lubricants. The characteristics of some dispersion media and lubricants are tabulated. Electron microscopic structure and the effect of the medium viscosity are graphically presented. Author (TAB)

N70-40061*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

HONEYCOMB PANELS FORMED OF MINIMAL SURFACE PERIODIC TUBULE LAYERS Patent Application

Alan H. Schoen, inventor (to NASA) Filed 16 Jul. 1970 22 p (NASA-Case-ERC-10364; US-Patent-Appl-SN-55537) Avail: NTIS CSCL 13M

The tubule layers are broken into elemental sections, which are defined as minimal surface elements, i.e., elements having a mean curvature at all points on the surface that is equal to zero. These elements are further defined inside of kaleidoscopic cells wherein they orthogonally intersect all faces of the kaleidoscopic cell with which they are associated at least once. The minimal surface elements are smoothly interconnected to form tubule layers which are stacked in a reflection image-like manner whereby the overall honeycomb core has no internal discontinuities. The honeycomb panels may be utilized as walls or floors in buildings, desk tops and panels in furniture construction, and in other similar environments where it is desired to have a relatively strong light-weight panel. NASA

N70-40071*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

HONEYCOMB CORE STRUCTURES OF MINIMAL SURFACE TUBULE SECTIONS Patent Application

Alan H. Schoen, inventor (to NASA) Filed 22 Jul. 1970 45 p (NASA-Case-ERC-10363; US-Patent-Appl-SN-57253) Avail: NTIS CSCL 13M

Honeycomb cores formed of tubule sections bounded orthogonally by plane facings are described. The tubule sections are defined as being formed of minimal surface elements that orthogonally intersect all of the surfaces of a kaleidoscopic cell at least once. In other words, the tubule sections are broken into elements for definition purposes. The elements are defined as minimal surface elements, i.e., elements that have a mean curvature that is equal to zero at all points on their surface. These elements are further defined inside of an imaginary kaleidoscopic cell in that they orthogonally intersect all surfaces of an imaginary kaleidoscopic cell at least once. Moreover, the tubule sections are smoothly interconnected to form honeycomb core structures that have no internal discontinuities. NASA

N70-40078# Aerospace Corp., San Bernardino, Calif. Technology Div.

HIGH QUALITY ABLATION EXPERIMENTAL RESULTS, PHASE 1 Technical Report, May – Nov. 1969

Wallis R. Grabowsky and Robert L. Strickler 10 Apr. 1970 109 p refs

(Contract F04701-69-C-0066)

(AD-707842; TR-0066(S5816-74-)-2; SAMSO-TR-70-215) Avail: NTIS CSCL 11/7

A series of nosetip ablation tests was recently performed. The report describes the objectives of the experiments, presents the data obtained, discusses the interpretation and analyses of the data conducted to date, and assesses the manner in which the program satisfied the original goals. Ablation data are presented for POCO graphite, R6300 carbon phenolic, and 3D quartz phenolic hemisphere/cone configurations in CWSH environments ranging from 70 to 120 atm. The models were also tested in an argon atmosphere to isolate thermomechanical mass loss effects. Author (TAB)

N70-40178# Naval Civil Engineering Lab., Port Hueneme, Calif.

RELATION BETWEEN CHANGES IN ELECTRICAL PROPERTIES AND PERFORMANCE OF COATINGS. EXPERIMENTS WITH THIRTEEN IMMERSED COATING SYSTEMS

Peter J. Hearst May 1970 53 p refs

(AD-707697; NCEL-TR-683) Avail: NTIS CSCL 11/3

In an attempt to find a relatively rapid method of predicting the performance of coatings, changes in electrical properties were compared with the results of long-term field performance of the coatings. Thirteen coating systems on steel panels were immersed in seawater in the laboratory for 400 days, and the AC and DC electrical properties of the coatings were determined. Earlier experiments had indicated a relationship between changes in electrical properties and performance. New results with coatings of comparatively good performance indicate some correlation between changes in electrical properties and coating performance. However, the correlation is not sufficiently high to allow reliable prediction of the comparative performance of good coatings. Author (TAB)

N70-40238# Boeing Scientific Research Labs., Seattle, Wash. Polymer Sciences Lab.

POLYQUINOXALINES CONTAINING p-PHENYLENE ETHER AND p-PHENYLENE MOIETIES

P. M. Hergenrother and D. E. Kiyohara Apr. 1970 24 p refs

(AD-708806; D1-82-0968) Avail: NTIS CSCL 7/3

A series of quinoxaline polymers containing p-phenylene ether and p-phenylene moieties were prepared by polymerization of 3,3-diaminobenzidine with various aromatic bisglyoxals in m-cresol. The glass transition temperature (Tg) of the polyquinoxalines varied from 133C for a polymer highest in p-phenylene ether content to 350C for a polymer containing rigid p-phenylene moieties. Although thermalgravimetric analysis failed to show any distinct difference between the p-phenylene ether and the p-phenylene polymers, isothermal weight loss study at 400C in air showed that the p-phenylene polymers lost less weight after a given time than the p-phenylene ether polymers. Prior to polymer work, a series of quinoxaline model compounds were prepared to aid in polymer characterization. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N70-39014# Paris Univ., Orsay (France). Lab. de Physique Theorique et Hautes Energies.

A GENERAL FORMULA FOR THE AVERAGE VALUES OF FEYNMAN INTEGRALS AND SOME CONSEQUENCES

D. Fakirov Jun. 1970 10 p refs

(Rept-70/27) Avail: NTIS

A general formula is obtained for averaging the integrand of Feynman integrals over the directions of the k-space. Author

N70-39051# Stanford Univ., Calif.

NUMERICAL TECHNIQUES IN MATHEMATICAL PROGRAMMING

R. H. Bartels (Tex. Univ., Austin), G. H. Golub, and M. A. Saunders

May 1970 64 p refs Presented at Nonlinear Programming Symp., Madison, Wis., 4–6 May, 1970 Supported in part by AEC and New Zealand Govt.
(SLAC-PUB-760; STAN-CS-70-162; CONF-700520-1) Avail: NTIS

The application of numerically stable matrix decompositions to minimization problems involving linear constraints is discussed and shown to be feasible without undue loss of efficiency. Computation and updating of the product-form of the LU decomposition of a matrix are described. It is shown that this can be applied to solving linear systems at least as efficiently as standard techniques using the product-form of the inverse. Orthogonalization via Householder transformations is described, with applications to least squares and quadratic programming algorithms based on the principal pivoting method of Cottle and Dantzig. The singular value decomposition is applied to the nonlinear least squares problem, and related eigenvalue problems are discussed. Author

N70-39053# Los Alamos Scientific Lab., N.Mex.
ENUMERATION OF STOCHASTIC MATRICES WITH INTEGER ELEMENTS
M. L. Stein and P. R. Stein Jun. 1970 19 p refs
(Contract W-7405-eng-36)
(LA-4434) Avail: NTIS

The problem treated is that of enumerating the number of nonnegative integer $n \times n$ matrices with common line sum r. The case in which the entries are restricted to be (0,1) is also treated. Although a general formula (for both cases) is given, it is not useful except for small r; the explicit expressions are written out for $r = 2, 3, 4$. Numerical enumeration is considered, and an efficient branching process for obtaining the enumerating numbers is described. Finally, several formulas of the Gupta type (fixed n, variable r) are given in the nonnegative integer case. The cases $n = 2, 3, 4$ are treated theoretically using an approach based on properties of the so-called Schur function coefficients of Kostka. Several numerical tables are included. Author

N70-39060 California Univ., Los Angeles
ALGEBRAIC METHOD IN THE STUDY OF RELATIVISTIC TWO-BODY PROBLEMS. PART 1: BETHE-SALPETER EQUATIONS. Part 2 QUASIPOTENTIAL EQUATIONS
Ying-Chuan Yang (Ph.D. Thesis) 1969 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 19514

The SO(4) Symmetry of the Bethe-Salpeter equation of Wick-Cutkowsky Model is studied in Minkowskian metric, and the hermiticity of generators of the SO(4) group is compared to the normalization condition of the BS equation. By introducing an SO(4,3) algebra, we present an algebraic form of the BS equation. The solution is then compared to the classical ones. A new continuous spectrum has been found which corresponds to the time-like separation of two particles. The trajectories of Lorentz poles are also discussed. The algebraic form of the quasipotential equation has been given. An SO(4,2) algebra is used and the operators of the Poincare group are then shown. The algebraic equation is solved by the operator method. From the boundary conditions discrete energy levels have been shown. Dissert. Abstr.

N70-39066 Pittsburgh Univ., Pa.
THE SUMMABILITY OF CAUCHY PRODUCTS OF DOUBLE SERIES
Edward James Smerek (Ph.D. Thesis) 1969 38 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-17813

The principal problem investigated is the matrix summability of Cauchy products of double series. The first set of results were three multiplication theorems for the Norlund mean. In each case, the summability of the Cauchy product of series summed by the mean was discussed. A result was also obtained on the inclusion of the Cesaro method of order one and a certain kind of regular Norlund method. Dissert. Abstr.

N70-39068 Michigan Univ., Ann Arbor.
COMPLETELY REGULAR MAPPINGS
Stephen Benjamin Seidman (Ph.D. Thesis) 1969 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18106

Two theorems of continuous surjection p: if E then B are proved. In theorem 1, the surjection is completely regular with fiber F, where F is locally compact and separable, and H(F) is LC sup O. Then p is a Serre fibration. If in addition B is a finite dimensional ANR, then p is locally trivial. In theorem 2, the surjection was completely regular with fiber F, where F is a compact ANR and B is locally compact and finite dimensional. The p is a Hurewicz fibration. There exist examples of completely regular mappings with compact fiber that are Hurewicz fibrations, but which are not locally trivial. Thus theorem 1 cannot be extended arbitrarily. Similarly, theorem 2 cannot be extended arbitrarily, as there exist completely regular mappings with compact fiber that are not even Serre fibrations. Dissert. Abstr.

N70-39073 Carnegie-Mellon Univ., Pittsburgh, Pa.
MATHEMATICAL PROGRAMMING SOLUTION OF OPTIMAL CONTROLS
Gerard Bashein (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-17502

The development of linear and quadratic programming algorithms and their application to control are considered. Several computational examples are solved that illustrate the power of the methods on both linear and nonlinear dynamical systems. An algorithm is derived for the open-loop solution of the linear minimum-time regulator problem. The storage requirements are small enough that the algorithm offers promise for implementation in a repetitive feedback mode on a small process control computer. A bounded variable modification is introduced into the Dantzig quadratic programming algorithm, which is applied iteratively to solve several problems with linear dynamics and convex cost functionals. Trajectory optimization for nonlinear, continuous-time systems with piecewise constant control is also considered. Computational results are presented for a method combining quasilinearization and quadratic programming. Dissert. Abstr.

N70-39088# Oak Ridge National Lab., Tenn.
KWIC INDEX FOR MATRICES IN NUMERICAL ANALYSIS. VOLUME 2: PRIMARY AUTHORS K-Z
A. S. Householder Jun. 1970 151 p refs
(Contract W-7405-eng-26)
(ORNL-4418-Vol-2) Avail: NTIS

This is a continuation of the index of items considered relevant to the numerical treatment of matrices, determinants, and linear systems of equations. A subsequent volume will include items of more recent publications and of additional papers and books in languages other than English whose titles are not yet translated. NSA

N70-39101 Rice Univ., Houston, Tex.
THE SYMMETRIC TOP SPIN-ROTATIONAL PARTITION FUNCTION
Douglas Ike Ford (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-19289

The symmetric top is capable of possessing much symmetry and provides a system for examining some of the consequences of the Pauli exclusion principle. Using group theory, the true degeneracy of an energy level can be found from the transformation properties of the sets of degenerate eigenfunctions. The resulting expression for the true degeneracy involves a summation over the

symmetry elements of the group involved. Interchanging the order of summation over the rotational energy levels and the summation over the symmetry elements, it is found that there is a contribution to the partition function from each of the symmetry elements. The usual approximation of dividing the sum over all states by the symmetry number amounts to keeping only the contribution from the identity element. The contributions from the other symmetry elements are shown to vanish extremely fast with increase in temperature. Dissert. Abstr.

N70-39102 City Univ. of New York.
ON EXTREMA IN SPACE-TIME
Mary Elizabeth Fox (Ph.D. Thesis) 1969 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19057

The clock time of a polygonal circuit on a finite set of events, S, in space-time is defined to be the sum of all the timelike separations of its rectilinear connections. A circuit P having either the least or the greatest clock time of all circuits in the covertex class of P (all circuits with the same vertex set as P) is referred to as a minimal or a maximal circuit on S. These constitute the extreme circuits on S. A semi-timelike distribution of events in space-time is a distribution that admits at least one circuit in which each rectilinear connection is timelike. Theorems are considered for the various types of circuits. Dissert. Abstr.

N70-39115 Florida State Univ., Tallahassee.
AN UPPER BOUND FOR THE NUMBER OF WILD POINTS ON A 2-SPHERE
Michael Dee Taylor (Ph.D. Thesis) 1969 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-17686

Let S be a 2-sphere in S3 with a complementary domain U. By w is meant the number of points of S which are wild from U. If U can be expressed as a monotone union of cubes with m holes but not as a monotone union of cubes with m-1 holes, then g(U) is defined and it is said g(U) is the genus of U. It is shown that under certain conditions g(U) is an upper bound for w, and under the same conditions there are examples for which g(U) is strictly greater than w. Dissert. Abstr.

N70-39119 Michigan Univ., Ann Arbor.
SOME SUBGROUPS OF THE FINITE UNITARY GROUP
Alan Heezen (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-18021

The determination is considered of the subgroups of the finite unitary group which contain an orthogonal or symplectic group. Geometric methods are used as much as possible, and there is considerable exposition of long known but little publicized details of the premultation properties of these groups. V denotes a vector space of finite dimension over the finite field K, and K is assumed to be odd in any discussion of the orthogonal group. We first formalize the imbedding of the orthogonal and symplectic groups in the unitary group. Elations and homologies are examined in this context, and the centralizers and normalizers in the unitary group of the orthogonal and symplectic groups are characterized both geometrically and algebraically. Dissert. Abstr.

N70-39145 Wisconsin Univ., Madison.
THE ASYMPTOTIC BEHAVIOR AND NUMERICAL SOLUTION OF SINGULAR PERTURBATION PROBLEMS WITH TURNING POINTS
Fred William Dorr, Jr. (Ph.D. Thesis) 1969 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 12359

The asymptotic behavior as epsilon approaches 0 sub positive of solutions u(t) = u(t, epsilon and v(t) = v(t, epsilon) to nonlinear boundary value problems. The problems may be considered as one-dimensional models of the two-dimensional steady state Navier-Stokes equations with large Reynolds number. The solutions to the one-sided difference equations for the problems are examined in detail and it is shown that they have precisely the same asymptotic behavior as solutions to the corresponding differential equations. Dissert. Abstr.

N70-39150 Massachusetts Univ., Amherst.
ON SUBFIELDS OF FINITE DEGREE UNDER A FUNCTION FIELD OF GENUS ZERO
Frederick James Dorey (Ph.D. Thesis) 1969 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19149

The field towers of function fields with genus zero are investigated employing the valuation theory. It is shown that not only Ritt's results on prime and composite complex polynomials but also his proof can be generalized. Therefore the proof is not dependent on analytic continuation or the classical topology of the Riemann surface. The true foundation of Ritt's method is that the formal power series field is quasi-finite. The generalized methods were used to determine all normal extensions. It is shown that any normal extension with a given Galois group is unique and the only choices for Galois groups are cyclic, dihedral, tetrahedral, octahedral, and icosahedral groups. The previous results mentioned are extended to include some cases when the constant field was of characteristic p unequal to 0. The problem of determining when a polynomial F(x) can be written as the composite of two other polynomials of degree larger than one is discussed. Dissert. Abstr.

N70-39151 Michigan Univ., Ann Arbor.
QUASICONFORMAL MAPPINGS AND STRONG LOCAL CONNECTIVITY
Michael Frederick Walker (Ph.D. Thesis) 1969 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-18130

Quasiconformal mappings in two- and three-dimensional space are studied. From a theorem of Teichmuller two results in the distortion theory of plane quasiconformal mappings are derived. One of these has also been obtained by Sia Dao-Shing by a parametric method. The other is used to prove that a plane K-quasiconformal mapping of the whole plane can be extended to a diffeomorphic K(2)-quasiconformal mapping of each of the half-spaces bounded by the plane: the method of proof is based on a construction given by Ahlfors. Next, for any K > 1, a K-quasiconformal mapping of the unit ball which maps a plane circular disc onto a set of non-sigma-finite two-dimensional Hausdorff measure is constructed. This result extends readily to n-space, n > or = to 2. Finally, strongly locally connected sets and their images under quasiconformal mappings are discussed. A characterization of the quasiconformal mappings of three-space is given in terms of a subclass of the strongly locally connected sets, namely the generalized circles. These results extend to n-space, n > or = to 3. Dissert. Abstr.

N70-39155 Wisconsin Univ., Madison.
CLOSED IDEALS AND LINEAR ISOMETRIES OF CERTAIN FUNCTION SPACES
Mahavirendra Hariprasad Vasavada (Ph.D. Thesis) 1969 92 p JVZ
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-12427

The spaces of continuously differentiable functions on [0,1], absolutely continuous functions on [0,1] and Lipschitz functions on a compact metric space are studied. These are denoted by C[0,1], AC[0,1] and Lip (X,d) respectively. (X,d) denotes a compact metric space with metric d. It is known that every closed ideal of the Banach algebra C[0,2] is the intersection of closed primary ideals containing it. Taking this result as the basis, it is shown that it is possible to provide a hull-kernel topology on the space of closed

primary ideals of C[0.1]. Using a theorem of Browder, it is shown that there exists a nonzero point derivation at every point of [0.1] on every closed subalgebra of C [0.1], which separates points and contains constants. Dissert. Abstr.

N70-39166# California Univ., Livermore. Lawrence Radiation Lab.
EXPALS: FORTRAN CODE FOR EXPONENTIAL APPROXIMATION BY LEAST SQUARES
C. Douglas Gardner 6 Mar. 1970 49 p refs Revised
(UCRL-14541-Rev-1) Avail: NTIS

EXPALS is a FORTRAN program for obtaining a weighted least-squares fit of a sum of exponentials to be run on CDC 6600 or IBM 7094 computers. This routine fits a linear combination of real exponential decay functions of the Prony-Householder iteration method. This report presents the mathematics and programming necessary to run EXPALS. Also included are output of examples to test the program. Author

N70-39171 Princeton Univ., N.J.
CURRENT ALBEGRAS AS UNITARY REPRESENTATIONS OF GROUPS
Gerald A. Goldin (Ph.D. Thesis) 1969 243 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 69-14411

It is possible that a complete physical theory can be written entirely in terms of operators such as current densities, rather than in terms of field operators. Models for nonrelativistic quantum mechanics, for charged scalar mesons, for quarks, etc., are reviewed, in which the equal-time current commutators, obtained heuristically from canonical field commutation or anticommutation relations, are taken as the starting point of a new theory. When the current commutators are computed in the Fock representation of the original field operators, they sometimes differ from the heuristically obtained commutation relations by a Schwinger term. The fact that such Schwinger terms usually cannot be ignored is reviewed. Dissert. Abstr.

N70-39185 City Univ. of New York.
A UNIQUENESS THEOREM IN THE CAUCHY PROBLEM FOR LINEAR PARABOLIC OPERATORS
David M. Ellis (Ph.D. Thesis) 1969 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-19056

A Hilbert space treatment is presented for proving uniqueness in the Cauchy problem for a general linear 2k-parabolic operator P. It is assumed that P has variable coefficients having bounded partial derivatives of all orders on R to the $n + 1$ power. A generalization of the classical energy inequality for R is established applicable to test functions on R to the $n + 1$ power. Then by using the fact that the spectrum of the symbol H is contained in a compact subset of the open left-half complex plane the inequality is proved. Certain estimates are applied from the theory of pseudo-differentials. By extending the energy inequality to distributions, uniqueness in the Cauchy problem for P is proved. The energy inequality is used to solve the Cauchy problem for R. Dissert Abstr.

N70-39232 Catholic Univ. of America, Washington, D.C.
THE MAXIMIZATION OF ENTROPY OF DISCRETE DENUMERABLE DISTRIBUTIONS
Roman A. Mureika (Ph.D. Thesis) 1969 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-18583

The entropy of a discrete random variable is the quantity H where the set of probabilities describes the distribution of the random variable. Necessary and sufficient conditions are found for denumerable sets of points S so that the maximum entropy of all random variables taking values in S and having known mean is finite. E.H.W.

N70-39248 Wisconsin Univ., Madison.
FINITE PARTIALLY-ORDERED QUANTIFICATION
Wilbur John Walkoe, Jr. (Ph.D. Thesis) 1969 81 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-12428

A first-order formula in prenex normal form can be described as the concatenation of a quantifier-prefix Q with a quantifier-free formula phi. Q can be thought of as a system < A, < > of linear order whose universe A is a set of quantifiers. The Skolem normal form of Q phi can be obtained from phi by replacing each variable eta which occurs in an existential quantifier of Q by a function symbol with the variables of all universal <-predecessors of eta as arguments, and forming the universal closure of the result. A generalization of first-order logic was suggested in which there are prefixes which are partially-ordered sets of quantifiers. If Q is such a prefix and phi is an ordinary quantifier-free formula, a Skolem normal form for Q phi is obtained in the same way as if the ordering of Q were linear, and Q phi is interpreted as the second-order existential quantification of its Skolem normal form. Dissert. Abstr.

N70-39249 Columbia Univ., New York.
EXTENSIONS OF HOMOMORPHISMS FROM NON-NORMAL SUBGROUPS
Robert Hugh Gilman (Ph.D. Thesis) 1969 31 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-17591

Relative cohomologies of other investigators are used to obtain sufficient conditions for a homomorphism of a subgroup L of a finite group G to extend to G. Extending one dimensional representations of solvable subgroups gives results about solvable quotients. For example if L is solvable and has order relatively prime to its index, and if the sequence R sub i is a collection of subgroups between L and G such that G = union sub i R sub i then L has a normal complement in G (a subgroup N normal in G such that LN = G, L intersection N = 1) if and only if it has one in each r sub i. Generalizations are obtained for solvable subgroups of some results on complements to arbitrary subgroups. Some results are proven on extending an arbitrary complex representation, T, of L. Some conditions are found for which the obstruction to extending T to G vanishes. For example if T is invariant and one dimensional and (G:L) is a prime, then T extends to G. Dissert. Abstr.

N70-39251 Michigan Univ., Ann Arbor.
QUASICONFORMAL MAPPINGS IN SPACE
Mavina Krishna Vamanamurthy (Ph.D. Thesis) 1969 84 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-18125

Three types of problems in the study of quasiconformal mappings in space are discussed. A pair of quasiconformal mappings in space, obtained by rotating two plane quasiconformal mappings which have an axial symmetry are presented. In general, mappings so obtained need not be quasiconformal in space. The Schwarz lemma enables the proof that space mappings are again quasiconformal. Some results of Gehring and Vaisala are extended on coefficients of quasiconformality of domains in space. The inner coefficient of a nonconvex cone is calculated and bounds for the outer coefficient of a nonconvex dihedral wedge as obtained. A local characterization of a quasiconformal disk is given by following a method similar to that of Gehring in characterization of a quasiconformal sphere. Dissert. Abstr.

N70-39257 Massachusetts Univ., Boston.
ORTHOGONALITY SPACES AND THE FREE ORTHOGONALITY MONOID
Robert James Weaver (Ph.D. Thesis) 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-19157

In the mathematical study of the logic of empirical science which was undertaken by C. H. Randall and D. J. Foulis, this

notion of distinguishability of results has given rise to the concept of an orthogonality space, a set of points on which is defined a symmetric irreflexive relation. Several aspects are developed of the rich structure which is inherent in these orthogonality spaces and certain ideas are discussed, in a general setting, which have come up in the above mentioned logical study. For example, a catalogue of the possibile results of an experimental procedure should at the same time be exhaustive and have its elements mutually distinguishable (orthogonal). Hence the maximal orthogonal subsets of an orthogonality space are the experiments or operations. In the material presented, efforts are directed towards setting up a partial order on the collection of operations and finding internal characterizations whereby two operations are comparable under this order. Dissert. Abstr.

N70-39298 Pittsburgh Univ., Pa.
GROUP THEORETIC PROPERTIES IN LIE ALGEBRAS
Ernest Lester Stitzinger (Ph.D. Thesis) 1969 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-17814

Since there are many similarities between solvable (nilpotent) finite groups and solvable (nilpotent) Lie algebras and since more is known about solvable (nilpotent) finite groups than their counterpart in Lie algebras, it seems natural to verify the validity of the corresponding statements, techniques and methods in Lie algebras. The material presented centers around this line of thought. The importance of the Frattini subgroup has long been known. Its Lie algebra counterpart is investigated. The hypercenter and weak hypercenter of a Lie algebra are studied. Analogous results for Lie algebras over an algebraically closed field of characteristic zero are found. Finally, a result on the Frattini subalgebra of an associative algebra is found. Dissert. Abstr.

N70-39351 Stanford Univ., Calif.
THE CLOSED IDEALS IN AN ALGEBRA OF ANALYTIC FUNCTIONS
Charles Madison Stanton (Ph.D. Thesis) 1969 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-17454

Let W be a finite Reimann surface with border Gamma. Let A(W) be the set of all functions which are analytic on W and continuous on W union Gamma. With the pointwise algebraic operations and the superemum norm, A(W) is a Banach algebra. The purpose of this dissertion is to describe the closed ideals in this algebra. The results generalize those of Beurling and Rudin. It was shown that W can be represented as a finite sheeted branched covering surface to the unit disc. This relationship of the two algebras A(Delta) and A(W), together with the ideal theory of A(Delta), to describe the ideal theory of A(W) was used. The basic method is to use the above described Ahlfors mapping and the Silov idempotent theorem to localize problems on the surface and reduce them to problems in the disc. Certain class of closed ideals in A(W) is described by using the ideal theory of the disc algebra. Dissert.Abstr.

N70-39352# Notre Dame Univ., Ind.
THE CONGRUENCE SUBGROUP PROBLEM OVER LOCAL FIELDS
Carl Riehm [1969] 16 p refs
(Grant NSF GP-8366)
Avail: NTIS

A topological group U is said to have congruence subgroup property if every normal subgroup of U, not contained in the center of U, is open. Borel pointed out the general occurrence in nature of this phenomenon, and that is is related to the fact that U is a k-analytic group with a nice Lie algebra. A determination is made of exactly when this phenomenon occurs in K simple groups in characteristic p. Theorems, lemmas and proofs are given in support of this contention. E.H.W.

N70-39360# Wisconsin Univ., Madison. Mathematics Research Center.
LINEARIZED RANK ESTIMATES FOR THE GENERAL LINEAR HYPOTHESIS Technical Summary Report
Charles H. Kraft and Contance van Eeden Nov. 1969 22 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-707795; MRC-TSR-1018) Avail: NTIS CSCL 12/1

Simply computable and efficient estimates from rank statistics are given for parameters of general linear hypotheses for fairly general sequences of design matrices. Author (TAB)

N70-39381# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
TOPOLOGICAL MOEBIUS SPACES [TOPOLOGISCHE MOEBIUSRAEUME]
Werner Heise (Ph.D. Thesis) 11 Dec. 1969 52 p refs In GERMAN
Avail: NTIS

An axiomatic description of Moebius space geometries is given in which the connecting circle for three differing points is considered. Construction of the circle geometry is performed analog to the projective geometry and a corresponding dimensional projective space is obtained. The topologies of the discussed Moebius spaces are determined by their affinitive subspaces and coordinates. Transl. by G.G.

N70-39383# Wisconsin Univ., Madison. Mathematics Research Center.
MINIMIZING A CONCAVE FUNCTION IN A CONVEX POLYTOPE Technical Summary Report
T. C. Hu Sep. 1969 16 p refs
(Contract DA-31-124-ARO(D)-462; Grant NSF GP-8557)
(AD-707790; MRC-TSR-1011) Avail: NTIS CSCL 12/2

An algorithm is suggested for minimizing a concave function subject to linear constraints. The algorithm is very much like the Simplex Method except additional constraints are generated during the computation. Author (TAB)

N70-39400# Los Alamos Scientific Lab., N.Mex.
THE METHOD OF ODD/EVEN REDUCTION AND FACTORIZATION WITH APPLICATION TO POISSON'S EQUATION, PART 2
B. L. Buzbee, G. H. Golub, and C. W. Nielson May. 1970 35 p
(Contract W-7405-eng-36; Grant NSF GJ-798)
(LA-4288; STAW-CS-70-155) Avail: NTIS

Derived and generalized are the methods of Buneman for solving elliptic partial difference equations in a rectangular region. It is shown that Buneman methods lead to numerically accurate solutions whereas the CORF algorithm may be numerically unstable. Several numerical examples are given and discussed. Author

N70-39424# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
CONTROL OF A CLASS OF NONLINEAR DIFFUSIONS
J. Shapiro and G. Mon Dec. 1969 42 p refs
(CT-32) Avail: NTIS

The optimal control of a class of diffusion processes is considered. Specifically, given a system with plant modelled as a finite power series in the state and control variable, and given certain statistical properties of additive plant noise, the problem is to minimize the expected value of a performance index by selecting a feedback control having a prescribed form, a finite power series in the state variables, the coefficients of which are time functions to be determined. The systems considered possess conditional state density functions that satisfy the forward equation. Then assuming an exponential series solution of the forward equation, the original problem is transformed into one requiring the determination

of time functions that minimize a performance index while satisfying, together with the coefficients of the exponential expansion, an infinite set of ordinary differential equations. Author

N70-39437# Wisconsin Univ., Madison. Mathematics Research Center.
THE RATE OF CONVERGENCE OF THE RESET DAVIDON VARIABLE METRIC METHOD Technical Summary Report
Garth P. McCormick Oct. 1969 25 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-707791; MRC-TSR-1012) Avail: NTIS CSCL 12/2

The rate of convergence of the Reset Davidon Variable Metric Method is shown to be always superlinear and sometimes quadratic in cycles of n points when the limit point of the minimizing sequence has a positive definite Hessian matrix. Author (TAB)

N70-39438 University of Southern Calif., Los Angeles.
STATIONARY MEASURES ON BRANCHING PROCESSES
Yu Sang Yang (Ph.D. Thesis) 1969 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 17896

Harris' results on the existence of stationary measures on transient Markov chains to discrete time temporally homogeneous Markov process with delta compact metric state space X are generalized. A sufficient but not necessary condition which was applied to certain discrete time branching processes with set of types compact metric and to Galton-Watson processes allowing immigration was obtained. Examples on discrete time age dependent processes and one dimensional neutron model are given. A similar sufficient condition is obtained for continuous time branching denumerable Markov chains. For subcritical continuous time processes with set of types compact metric, it was proven, under some conditions, that when lim x approaches infinity Q(X, Q(x,·) there exists in the sense of weak convergence Q(X, ·) = integral infinity sub 0 P(t, x, ·)dt, P(T,X, ·). The asympototic behavior of this stationary measure is studied. Some results on generating functionals and weak convergence are also obtained. Dissert. Abstr.

N70-39448# Technische Hochschule Hannover (West Germany).
LOCALLY UNBOUNDED TOPOLOGICAL REGIONS OF CONVERGENCE [LOKAL-UNBESCHRAENKTE TOPOLOGISCHE KOERPER]
Juergen Heine (Ph.D. Thesis) 1970 48 p refs In GERMAN
Avail: NTIS

Construction of a locally unbounded region by extending the general topology of real numbers in a polynomial ring to an unlimited ring topology is described. Considered is an arbitrary region with a bounded ring topology that satisfies the first countability axiom. It is shown that any domain with the characteristics 0, or which is not algebraic over its primary region, allows for this type of topology. Chain extension of the limited topology to the polynomial ring is then used for imbedding into a quotient ring. Transl. by G.G.

N70-39486# Yale Univ. New Haven, Conn. Dept. of Engineering and Applied Science.
DIFFUSIONS AND STOCHASTIC GAMES
Gordon R. Mon Apr. 1970 19 p refs
(CT-33) Avail: NTIS

A procedure for solving a particular well defined class of stochastic optimization problems is used to solve a class of zero-sum two-person games. Player P(1), wishes to minimize a scalar-valued functional whereas his opponent P(2) wants to maximize it; they attempt to achieve their respective objectives by selecting the feedback controls u = u(t,x) aand v = v(t,x), P(1) choosing u and P(2) choosing u and P(2) choosing v. The functional includes the termination time, expectation, and the state of the game. The evolution of the game is non-deterministic; it is assumed that x(t) is a strong Markov process and its conditional probability density function satisfies the evolution rule. Author

N70-39477# Technische Hochschule Hannover (West Germany). Fakultaet fuer Natur- und Geisteswissenschaften.
RELATIONSHIPS BETWEEN TYCHONOFF SPACES AND THEIR RING FUNCTIONS [BEZIEHUNGEN ZWISCHEN TYCHONOFF-RAEUMEN UND IHREN FUNKTIONENRINGEN]
Gerhard Merziger (Ph.D. Thesis) 9 Jul. 1969 53 p refs In GERMAN
Avail: NTIS

The relationship between homomorphisms of spaces and isomorphisms of corresponding functional rings is studied in order to determine the topological properties of the space X in the algebraic characterization of the ring C(X). Real compact Tychonoff spaces in the ring structure of C(X) are topologically defined by the ring structure C; the algebraic structure of the functional ring C determines whether or not the topological space can be normalized. Transl. by G.G.

N70-39478# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
A GENERALIZATION OF SOME KRYLOW THEOREMS AND THEIR APPLICATION TO DERIVATION FREE ERROR ESTIMATION IN NUMERICAL QUADRATURE [EINE VERALLGEMEINERUNG EINIGER SAETZE VON KRYLOW UND IHRE ANWENDUNG AUF DIE ABLEITUNGSFREIE FEHLERABSCHAETZUNG BEI NUMERISCHER QUADRATUR]
Klausjuergen Schnoege (Ph.D. Thesis) 5 Nov. 1969 89 p refs In GERMAN
Avail: NTIS

Generalized Krylow theorems are used to approximate procedural errors during numerical quadrature of the real value function of a real variable over a finite real interval. Considered are only linear numerical integration formulations that utilize equal distance supporting points on the integer interval. Transl. by G.G.

N70-39479# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
TOPOLOGICAL INCIDENCE GROUPS [TOPOLOGISCHE INZIDENZGRUPPEN]
Kay Soerensen (Ph.D. Thesis) 10 Jul. 1969 40 p refs In GERMAN
Avail: NTIS

Affinity conditions between topological and geometrical structure are considered in order to derive a coordination topology for a Desargue incidence group. An axiom system for n-dimensional topologically projective subgroups provides point- and hypersurface quantities with topologies so that mapping of n-independent points on the their projected hypersurfaces and the projection of independent hypersurfaces on their intersecting points remains constant. A corresponding axiom system for anon-projective groups is used to show that incidence groups can be imbedded into topologically projective groups; in the latter case, each finite dimensional Desargue incidence group possesses a coordination topology so that each n-dimensional affinity space has an isomeric group. Transl. by G.G.

N70-39480# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
PRIMARY AND TERTIARY FORMULATIONS IN A NON-COMMUTATIVE AND NON-ASSOCIATIVE SYSTEM [PRIMAERE UND TERTIAERE DARSTELLUNGEN IN EINEM NICHT-KOMMUTATIVEN UND NICHT-ASSOZIATIVEN SYSTEM]
Dirk Windelberg (Ph.D. Thesis) 9 Jul. 1969 48 p refs In

GERMAN
Avail: NTIS

Noether's ideal theory for rings, which satisfy increased chain conditions of a primary formulation by representing the primary as the smallest common multiple of finite numerous primary ideals, is expanded and applied to non-commutative and non-associative rings. Transl. by G.G.

N70-39482# Washington Univ., St. Louis. Dept. of Applied Mathematics and Computer Sciences.
MULTI-DIMENSIONAL PIECEWISE POLYNOMIAL CURVE FITTING
Philip B. Zwart [1969] 13 p refs
(Contracts AT(11-1)-1493, F44620-69-C-0116; Proj. THEMIS)
(COO-1493-34) Avail: NTIS

Linearly partitioned piecewise polynomials (LPPP) are examined, when polynomials on each of these pieces are put together in a smooth manner. An LPPP canonical form is presented which leads to computationally feasible multidimensional piecewise polynomial curve fitting. Author

N70-39483# Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences.
NONLINEAR PROGRAMMING: THE GLOBAL USE OF THE LAGRANGIAN
Philip B. Zwart [1969] 16 p refs
(Contracts AT(11-1)-1493; F44620-69-C-0116; Proj. THEMIS)
(COO-1493-29) Avail: NTIS

In some constrained nonlinear programming problems possessing multilocal optima, a local optimim can be recognized as the global optimum by looking closely at the Lagrangian, the augmented function. Classes of constrained optimization problems, such as geometric programming problems, can be recognized as possessing at most a single local optimum. Author

N70-39501# Wisconsin Univ., Madison. Mathematics Research Center.
HIGHLY ACCURATE NUMERICAL SOLUTION OF CASILINEAR ELLIPTIC BOUNDARY VALUE PROBLEMS IN n DIMENSIONS Technical Summary Report
Victor Pereyra Sep. 1969 29 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-707785; MRC-TSR-1009) Avail: NTIS CSCL 12/1

Iterated deferred corrections, a procedure to increase the asymptotic order of discretization algorithms, is applied to elliptic boundary value problems in n dimensions. Both linear and casilinear equations are considered, and numerical results are presented. Author (TAB)

N70-39502# Wisconsin Univ., Madison. Mathematics Research Center.
LIESE 2: A PROGRAM FOR ORDINARY DIFFERENTIAL EQUATIONS USING LIE SERIES Technical Summary Report
H. Knapp and G. Wanner Aug. 1969 158 p
(Contract DA-31-124-ARO(D)-462)
(AD-707769; MRC-TSR-1008) Avail: NTIS CSCL 12/1

The report describes a program which computes the solutions of ordinary differential equations using Lie-series. The program accepts the system of equations in a FORTRAN-like notation and uses double precision arithmetic throughout. The various subroutines may be used for the automatic generation of Taylor-coefficients as well as for the calculation of the Jacobian of a system of functions. Author (TAB)

N70-39514# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
EXPEDIENT AND OPTIMAL VARIABLE-STRUCTURE STOCHASTIC AUTOMATA
R. Viswanathan and Kumpati S. Narendra Apr. 1970 74 p refs
(CT-31) Avail: NTIS

The basic concept considered here depicts a closed loop structure consisting of an automaton and an environment. Several optimal and nonoptimal schemes using linear and nonlinear updating procedures are developed, and general conditions for achieving optimality are derived. The problem of speed of convergence of automata is discussed and several schemes with improved convergence rates are reported. E.M.C.

N70-39523# Rocketdyne, Canoga Park, Calif.
ESTIMATION OF LOCATION AND SCALE PARAMETERS UNDER VARIOUS MODELS OF CENSORING AND TRUNCATION
Nancy A. Mann Wright-Patterson AFB, Ohio ARL Feb. 1970 186 p refs
(Contract AF 33(615)-2818)
(AD-707868; ARL-70-0026) Avail: NTIS CSCL 12/1

The report consists of five papers which are related by the fact that all apply to the estimation of location and scale parameters under various types of censoring of a sample and truncation of a distribution. All of the papers are applicable to the first asymptotic distribution of smallest (extreme) values. The first, fourth and fifth papers give tables for estimating the parameters of this distribution for specified models of distribution truncation and sample censoring. The second paper, an earlier version of which appeared as Rocketdyne Research Report RR 63-41, has been rewritten under this contract and included in this report because some of its preliminary results are used elsewhere in the report. The third paper generalizes the second and was written under the contract; both are concerned with best invariant estimation of location and scale parameters. Author (TAB)

N70-39527# Technische Hochschule Hannover (West Germany).
COMPACT BOUNDED RIEMANN SPACES THEOREMS, ASSUMPTIONS, COUNTER EXAMPLES [KOMPAKTE BERNANDETE RIEMANNSCHE FLAECHEN SAETZE, VERMUTUNGEN, GEGENBEISPIELE]
Steffen Timmann (Ph.D. Thesis) 1969 57 p refs In GERMAN
Avail: NTIS

Normal functions of finite Riemann spaces are obtained directly from meromorphic functions of their Schottky duplications and a criterium is provided that shows when a bounded Riemann space is a duplication of a bounded compact space. It is proven that existing finite Rieman spaces of arbitrary high genus can be imbedded holomorphic into hyperelliptical, as well as into non-hyperalliptical bounded Reiman spaces of the same genus. Transl. by G.G.

N70-39530# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
PROJECTIVE CLOSURE OF INCIDENCE STRUCTURES WITH SPECIFIC LIMITATIONS [PROJEKTIVE ABSCHLUESSBARKEIT VON INZIDENZSTRUKTUREN MIT EIGENTLICHKEITSBEREICH]
Guenter Graumann (Ph.D. Thesis) 10 Jul. 1969 65 p refs In GERMAN
Avail: NTIS

Basic aspects of the imbedding of absolute geometric group spaces into three dimensional projective spaces are considered and several axioms outlined. It is shown that under certain conditions proof for Desargues' theorem is transferable onto geometrices in incidence space which possess the main characteristics of incidence structures. Proofs are also provided for a weaker and a stronger version of Desargues' law, depending on the axiom used. Transl. by G.G.

N70-39531# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
ON THE ENLARGEMENT OF STRUCTURES [ZUR VERGROESSERUNG VON STRUKTUREN]
Klaus-Peter Podewski (Ph.D. Thesis) 23 Jan. 1970 47 p refs In GERMAN
Avail: NTIS

Model theory is evaluated for its application in arithmetical extensions of natural numbers to whole number systems. Considered is the question, whether each model N = (N, +, , s) of natural numbers can be enlarged into a model M = (M,epsilon) of a metatheory so that the natural metatheoretical definitions for natural numbers, their addition, multiplication, and ordering in M result in N. It is shown that extension is not always possible in the above described case. Transl. by G.G.

N70-39535*# International Business Machines Corp., Yorktown Heights, N.Y. T. J. Watson Research Center.
THEORY OF CUBICAL COMPLEXES WITH APPLICATIONS TO DIAGNOSIS AND ALGORITHMIC DESCRIPTION Quarterly Report, 16 May – 10 Aug. 1970
J. Paul Roth 10 Aug. 1970 10 p Prepared for JPL
(Contracts NAS7-100; JPL-952709)
(NASA-CR-113598; QR-2) Avail: NTIS CSCL 12A

Research progress is reported on a 2-level Boolean minimization PL/1 program, module diagnosis, diagnosis of circuit failures in which the circuits are described by higher-level blocks, parallel execution of algorithms, comparison of various algorithms for computing diagnostic tests, and a notation for the description of algorithms. R.B.

N70-39540# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik, und Naturwissenschaften.
ON AN INCREASED PRECISION FOR INTUITIONISTIC LOGIC [UEBER EINE VER SCHAERFUNG DER INTUITIONISTISCHEN LOGIK]
Sabine Goernemann (Ph.D. Thesis) 18 Dec. 1969 54 p refs In GERMAN
Avail: NTIS

Simplified is the Grzegorczyk model formulation for intuitionistic logic by a calculus developed from the intuitionistic functional calculus with the help of the distribution law. Language and syntax of the calculus are defined. Transl. by G.G.

N70-39654# Rocketdyne, Canoga Park, Calif.
EXTENSION OF RESULTS CONCERNING PARAMETER ESTIMATORS, TOLERANCE BOUNDS AND WARRANTY PERIODS FOR WEIBULL MODELS Final Report
Nancy R. Mann Wright-Patterson AFB, Ohio ARL Jan. 1970 67 p refs
(Contract AF 33(615)-2818)
(AD-708159; ARL-70-0010) Avail: NTIS CSCL 14/4

The report consists of three papers, all of which apply to the two-parameter Weibull distribution. The first paper gives tables for obtaining estimates of the shape parameter and of distribution percentage points. The paper provides a more extensive range of values than are available in the published article to which the tables apply. The second and third papers extend previous results. The second applies to the calculation of warranty periods from sample data for a lot to be manufactured in the future. Warranty periods to be calculated from three ordered observations are derived for orderings of the three observations not considered earlier. Investigation is made of the expected squared deviations of the calculated log warranty periods from the first failure in the lot to be manufactured in the future. On the basis of this investigation, a tabulation is given for lots of size n, n = 10, 11, ..., 25 and samples of size m, m = 2, 3, ..., n-3. The third paper considers Taylor series approximations to the distribution of three-order-statistic estimators of reliable life. By use of this approach, published tables of values for obtaining three-order-statistic confidence bounds on reliable life are extended. Author (TAB)

N70-39656# Naval Research Lab., Washington, D.C. Mathematics Research Center.
ON A CLASS OF MEROMORPHIC FUNCTIONS AND THEIR DERIVATIVES Final Report
Chung-chun Yang 16 Jan. 1970 5 p refs
(AD-708375; NRL-6990) Avail: NTIS CSCL 12/1

Let F be a meromorphic function with the order of F/F less than 1/2, and the quotient (p(z) F double prime (z)-Q(z)F(z))/F be a rational function for some polynomials p(z) and Q(z), where p(z) and Q(z) are not both identically zero. Then F(z) = P sub 1(z)/P sub 2 (z)) e to the power ((P sub 3)(z)), where P sub i(z), i = 1,2,3, are polynomials. Author (TAB)

N70-39658# Army Foreign Science and Technology Center, Washington, D.C.
FORMULAS FOR INTEGRATION WITH MINIMAL ERROR [FORMULY INTEGRIROVANIYA NAIMENSHEI PROGRESHNOSTYU]
A. V. Lebedev 7 May 1970 34 p Transl. into ENGLISH from Russian Rept.
(AD-707680; FSTC-HT-23-619-70) Avail: NTIS CSCL 12/1

Optimal quadrature formulas are constructed for a class of integral functions having a limited derivative of order r > 2 and with higher order of approximation. The number of nodes is limited such that only certain nodes will vary. Author (TAB)

N70-39667# Wisconsin Univ., Madison. Mathematics Research Center.
SOLUTION OF THE HELMHOLTZ EQUATION ON A SQUARE FOR A REACTIVE SCATTERING MODEL Technical Summary Report
Peter D. Robinson Oct. 1969 17 p refs
(Contract DA-31-124-ARO(D)-462; Grant NSF GP-12832)
(AD-707776; MRC-TSR-992) Avail: NTIS CSCL 12/1

Solutions of the Helmholtz equation ((the second partial derivative with respect to x) + (the second partial derivative with respect to y) + k squared + 1)pai = 0 describing a simple scattering process in an L-shaped region are studied. To obtain the correct expansion for pai(x,y) on the square corner of the L-shape when k = 1, it is found necessary to replace terms sin kx sin y and sin x sin ky by sin x sin y and (x cos x sin y - y cos y sin x). Terms similar to the latter have been neglected by previous authors and spurious resonances found in consequence. Author (TAB)

N70-39675# New York Univ., N.Y. Dept. of Electrical Engineering.
ON THE MATCHING OF POINTS IN DIFFERENT PERSPECTIVE PROJECTIONS OF THE SAME SUBJECT
Andrew D. Rabinowitz Dec. 1969 53 p refs
(Grant AF-AFOSR-1854-70)
(AD-707882; TR-403-10; AFOSR-70-1688TR) Avail: CFSTI CSCL 12/1

When analyzing a set of perspective projections of the same subject, it is important to be able to identify those points (one in each projection) that correspond to the projection of the same point of the subject. This must be done for each point of the subject if an accurate reconstruction of the subject from the projections is desired. The report describes a method for finding this correspondence for a pair of projections at a time. All configurations in which the projections can be aligned (assuming restrictions to make the alignments practical) are considered. Author (TAB)

N70-39710# Wisconsin Univ., Madison. Mathematics Research Center.
ITERATION OF POSITIVE APPROXIMATION OPERATORS

S. Karlin and Z. Ziegler 1969 54 p refs
(Contracts DA-31-124-ARO(D)-462; N00014-67-A-0112-0015)
(AD-707794; MRC-TSR-1010; TSR-10) Avail: NTIS CSCL 12/1

An analysis is given of the limit behavior of the k(n)-th iterates of positive linear approximation operators L sub n, as n and k(n) tend to infinity. Author (TAB)

N70-39723 California Univ., Berkeley.
AN APPROACH TO SYSTEM IDENTIFICATION
Edward Miller Butler (Ph.D. Thesis) 1969 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-18889

The problem is considered for continuous time data and for both linear and nonlinear differential equation models. It is assumed that only the input and output (no derivatives) from the unknown system are available, and that the index of identification is a time integral of some error function of the difference between the outputs of the unknown and the model, when the model is excited by the given input. Two gradient expressions are derived, one which requires the adjoint system solution in backwards time, and one which provides the gradients in forward time. The close relationship of identification to sensitivity and observability as well as the growing of new dimensions in state space are discussed. A generalized model for state variable representations of linear, dynamic systems for an equation error approach to identification is derived. Dissert. Abstr.

N70-39734# Brown Univ., Providence, R.I. Div. of Engineering.
ON GENERAL PURPOSE PROGRAMS FOR FINITE ELEMENT ANALYSIS, WITH SPECIAL REFERENCE TO GEOMETRIC AND MATERIAL NONLINEARITIES
Pedro V. Marcal May 1970 35 p refs Symp. on Numerical Solution of Partial Differential Equations, College Park, Md., May 1970
(Contract ARPA SD-86)
(AD-707792; ARPA-E73) Avail: NTSI CSCL 12/1

A summary of the state-of-the-art in nonlinear finite element analysis is made by describing a nonlinear theory and presenting some case studies. The formulation is applicable to problems of large displacement and small strains. The paper then focuses on the general purpose program. The concept and development of a general purpose program is described. A discussion is then made of the different sizes of problems which can be solved by such a program. These sizes are dependent on the available computer core. The conclusion is made that the general purpose program is a powerful means of implementing finite element analysis over a wide spectrum of problems in structural mechanics. Author (TAB)

N70-39746# Washington Univ., Seattle.
SCALE FREE REDUCED RANK IMAGE ANALYSIS
Paul Horst Jun. 1970 30 p refs
(Contract Nonr-477(33); Grants PHS-2-R01-MH00743-14; PHS-2-R01-MH00743-15)
(AD-708058) Avail: NTIS CSCL 12/1

In the traditional Guttman-Harris type image analysis, a transformation is applied to the data matrix such that each column of the transformed data matrix is the best least squares estimate of the corresponding column of the data matrix from the remaining columns. The model is scale free. However, it assumes (1) that the correlation matrix is basic and (2) that the data matrix is free of measurement errors. In this paper a more generalized model is developed that does not require these two assumptions. Computational procedures are suggested. Author (TAB)

N70-39766*# California Univ., Santa Barbara.
LOCALIZATION OF THE EIGENVALUES OF LINEAR INTEGRAL EQUATIONS WITH APPLICATIONS TO LINEAR ORDINARY DIFFERENTIAL EQUATIONS
James M. Sloss and Stan K. Kranzler [1970] 29 p refs
(Grant NGR-05-010-008)
(NASA-CR-86439) Avail: NTIS CSCL 12A

Integral equations of the form: phi(P) = lambda times the integral of D of K(P,Q)phi(Q)dQ + f(Q) are considered, where D is a bounded measurable set of R sup d, Euclidean space is of dimension d, K(P,Q) is defined and square integrable over D x D (not necessarily symmetric), f is defined and square integrable over D, and phi is the unknown function. It is shown that the eigenvalues of the equation can be approximated by the reciprocal eigenvalues of a finite matrix k sup m = (k sub ij) of order m that is easily determined from K. An explicit error estimate for the approximation that depends on K and m is derived. The results are applied to the problem of effectively approximating the eigenvalues of a self adjoint ordinary differential equation. Author

N70-39814# California Univ., Los Angeles.
THE CATEGORY OF SEMILATTICES
Alfred Horn and Naoki Kimura [1970] 23 p refs Submitted for publication Prepared in cooperation with Arkansas Univ., Fayetteville
(Grants NSF GP-9044; NSF GP-7429)
Avail: Issuing Activity

The injective and projective semilattices are determined. Explicit constructions are given for the injective hull and projective cover (when it exists) of a semilattice. Thus the category of semilattices is seen to be unusually amenable and a good source of illustrations for the concepts of category theory. A semilattice is an algebra with a binary operation which is associative, commutative and idempotent. Any partially ordered set in which any two elements have a greatest lower bound (meet) is a semilattice under the meet. Author

N70-39825# California Univ., Davis.
HIGHER DIMENSIONAL ANALOGUES OF AN ISOPERIMETRIC INEQUALITY OF BENSON
C. D. Chakerian [1970] 15 p refs
(Grant NSF GP-8188)
Avail: Issuing Activity

The proof is given of for a higher dimensional analog for convex bodies, and concepts needed for the proof are reviewed. Related inequalities of Bonnesen, integral inequalities resulting from the main inequality, and the question of finding further generalizations are considered. Equality holds for the main inequality if and only if the 3-dimensional body is a cylinder capped with hemispheres. N.E.N.

N70-39829# Hawaii Univ., Honolulu.
ON A CLASS OF TWO-PERSON, ZERO-SUM GAMES WITH VECTOR-VALUED PAYOFF FUNCTIONS
Rahul Chattopadhyay May 1970 7 p refs
(Contract F44620-69-C-0030; Grant NSF GK-4984)
(AD-708150; Themis-A70-9; AFOSR-70-1792TR) Avail: NTIS CSCL 12/2

The report considers a class of two-person, zero-sum games with vector-valued payoff functions. The existence of vector-saddle-points for such games is proved by using the concept of dominant strategies. TAB

N70-39836# Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences.
ALGORITHM FOR SOLVING INTEGER LINEAR PROGRAMMING PROBLEMS
Leon Cooper [1969] 24 p refs
(Contract AT(11-1)-1493)
(COO-1493-31) Avail: NTIS

An algorithm is described to solve integer linear programming problems based on the idea of solving as a linear diophantine equation a constraint parallel to the objective function hyperplane and then ascertaining of the original constraint inequalities and the

linear diophantine solution have an integer solution in common. Some computational considerations which may affect the applicability of the algorithm to problems with many variables are also briefly discussed. Author (NSA)

N70-39841*# Georgia Univ., Athens.
ESTIMATION IN TRUNCATED POISSON DISTRIBUTIONS WITH CONCOMITANT EXPOSURE INTERVALS AND TRUNCATION POINTS Final Report
A. Clifford Cohen Aug. 1970 14 p refs
(Contract NAS8-11175)
(NASA-CR-61335) Avail: NTIS CSCL 12A

Let the set x sub i, i = 1, ..., n, denote random observations of a truncated poisson variable with parameter t sub i, where the t sub i are known positive numbers, and where truncation points c sub i are specified such that x sub i > or = c sub i. Solutions (estimates) are readily found using trial and error procedures with linear interpolation, but any standard iterative procedure would be applicable. The asymptotic variance of lambda is obtained from the second partial of the likelihood function. An illustrative example is included. Author

N70-39869# Stanford Univ., Calif. Dept. of Operations Research.
WEAK CONVERGENCE FOR THE SUPERPOSITION AND THINNING OF POINT PROCESSES
Douglas P. Kennedy May 1970 35 p refs
(Contract N00014-67-A-0112-0031; Grant NSF GP-8790)
(AD-707995; TR-11) Avail: NTIS CSCL 12/2

Weak convergence theorems are obtained for which the limiting distribution is a Poisson process on D(0,1). Author (TAB)

N70-39870# Stanford Univ., Calif. Dept. of Operations Research.
FUNCTIONAL LIMIT THEOREMS FOR THE QUEUE GI/G/1 IN LIGHT TRAFFIC
Donald L. Iglehart Jun. 1970 26 p refs
(Contract N00014-67-A-0112-0031; Grant NSF GP-8790)
(AD-707996; TR-13) Avail: NTIS CSCL 12/2

A GI/G/1 queueing system in light traffic has the property of returning to the idle state infinitely often. The purpose of the paper is to exploit this property to develop limit theorems for several processes generated by this system. The principal processes of interest are the following: W sub n, the waiting time of the nth customer; Q(t), the number of customers in the system at time t; W(t), the virtual waiting time at time t; B(t), the amount of time the server is busy in (0,t); I(t), the amount of tie the server is idle in (0,t); and D(t), the cumulative number of customers departing the system in (0,t). TAB

N70-39873# California Univ., Davis.
A NON-CONTINUOUS STEINER POINT
G. T. Sallee [1970] 5 p refs
(Grant NSF GP-8188)
Avail: Issuing Activity

A function is constructed on the space of compact, convex sets which has all properties of the Steiner point except for continuity. The current state of the problem to characterize the Steiner point axiomatically is reviewed. Author

N70-39874# California Univ., Los Angeles.
PROJECTIVE DISTRIBUTIVE LATTICES
Raymond Balbes and Alfred Horn Submitted for publication Prepared in cooperation with Missouri Univ., St. Louis
(Grants NSF GP-11893; NSF-GP-9044)
Avail: Issuing Activity

It will be shown that a countable distributive lattice is projective if and only if the product of any two join irreducible elements is join irreducible, and every element of the lattice is both a finite sum of join irreducible elements and a fininte product of meet irreducible elements. For an arbitrary distributive lattice, necessary and sufficient conditions for projectivity are obtained by adding to these conditions a further condition on the set of join irreducible elements. Author

N70-39875# California Univ., Davis.
REULEAUX POLYTOPES
G. T. Sallee [1970] 18 p refs
(Grant NSF GP-8188)
Avail: Issuing Activity

This work takes place in E(d), d-dimensional Euclidean space, with unit ball B. Unless specifically noted to the contrary, all sets will be presumed to be closed and convex. If X is a subset of a sphere S with center p, X is spherically convex if X is contained in some open hemisphere of S and if the cone generated by X with vertex p is convex. The distance between two points will be denoted | x - y |k sub 1, k sub 2 are two convex sets, rho(k sub 1, k sub 2) will mean the unusual Hausdorff distance between them. An example construction to define Reuleaux polytopes is given and it is shown that this special class is dense in sets of constant width for d = 3. Author

N70-39888# Midwest Research Inst., Kansas City, Mo.
A CONVERGENCE THEOREM FOR NONCOMMUTATIVE CONTINUED FRACTIONS
Wyman Fair Wright-Patterson AFB, Ohio ARL Mar. 1970 12 p ref
(Contract F33615-69-C-1564)
(AD-708163; ARL-70-0040) Avail: NTIS CSCL 12/1

A convergence theorem is proved for a continued fraction whose elements are members of a complex Banach algebra. This is a generalization of a well-known theorem when the elements are scalars. Author (TAB)

N70-39903# Brown Univ., Providence, R.I.
STOCHASTIC DIFFERENTIAL EQUATIONS IN HILBERT SPACE
Peter L. Falb and Ruth F. Curtain (Purdue Univ., Lafayette, Ind.) Jun. 1970 35 p refs Prepared in cooperation with Purdue Univ.
(Grant AF-AFOSR-693-67)
(AD-708140; AFOSR-70-1765TR) Avail: NTIS CSCL 12/1

Existence and uniqueness theorems for stochastic evolution equations are developed in a Hilbert space context. The results are based on a blending of the theorems for evolution equations with stochastic integration for Hilbert space valued random processes. The results are applied to stochastically forced parabolic partial differential equations such as has arised in heat transfer problems. Author (TAB)

N70-39910# California Univ., Los Angeles. School of Engineering and Applied Science.
A STUDY IN FINAL-VALUE CONTROL
Merlin Clarence Leiding Apr. 1970 113 p refs
(Contract F04701-69-C-0182; Grant AF-AFOSR-699-67)
(AD-708152; UCLA-70-20; AF-AFOSR-699-67) Avail: NTIS CSCL 12/1

The difficulty encountered in operating a final-value control system in a closed-loop configuration is that the feedback gains become infinite at the final time and thus are impossible to implement. This thesis examines several alternative configurations to the closed-loop system for the Titan III booster using Flight Plan I pitch steering. Author (TAB)

N70-39928# Center for Naval Analyses, Arlington, Va.
TESTING OF A SUBSET OF THE OVERIDENTIFYING RESTRICTIONS
Joseph B. Kadane 19 Jun. 1970 11 p refs *Its* CNA Professional Paper No. 37
(AD-708349) Avail: NTIS CSCL 12/1,

Anderson and Rubin derived the likelihood ratio statistic

for testing a particular overidentified model against the alternative that the model is just or underidentified. One problem with this test, as emphasized by Christ among others, is that consequences of rejecting the null hypothesis are not clear: what restrictions were wrong. Additionally, possibly some of the restrictions are suspect but others, enough to overidentify the model, are not. How the suspect overidentifying restrictions can be tested is the subject of the paper. Author (TAB)

N70-39934# Technology, Inc., Dayton, Ohio.
NOMOGRAPH CONSTRUCTION METHODS Final Report, 30 Apr. 1967 – 30 Apr. 1969
Robert R. Yeager Wright-Patterson AFB, Ohio AFFDL Apr. 1970 35 p refs
(Contract F33615-67-C-1538)
(AD-708172; AFFDL-TR-69-44) Avail: NTIS CSCL 12/1

The report presents nomographic methods developed to graphically represent the various functional relationships between three or more parameters interrelated by equations. Also included are methods developed to vary both the form and the size of given nomographs. These developments were based on collinear techniques. Author (TAB)

N70-39942# Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences.
TRANSPORTATION-LOCATION PROBLEM
Leon Cooper [1969] 48 p refs
(Contract AT(11-1)-1493)
(COO-1493-30) Avail: NTIS

The Hitchcock transportation and location-allocation problem with unlimited capacities is studied in its generalized form. Consideration is given to deriving a more general formulation for the problem. A set of cost functions defined. The functions depend on the relative location of the sources with respect to destinations and weight. The objective is to minimize total cost subject to capacity and requirement constraints. E.H.W.

N70-39992# Stanford Univ., Calif. Dept. of Computer Science.
PROPERTIES OF PROGRAMS AND PARTIAL FUNCTION LOGIC
Zohar Manna and John McCarthy Oct. 1970 25 p refs
(Contract ARPA SD-183)
(AD-708071; SU-AIM-100) Avail: NTIS CSCL 12/1

Recursive definitions are considered which consist of Algol-like conditional expressions. By specifying a computation rule for evaluating such recursive definition, it determines a partial function. However, for different computation rules, the same recursive definition may determine different partial functions. Two types of computation rules are distinguished: sequential and parallel. The purpose of the paper is to formalize properties (such as termination, correctness and equivalence) of these partial functions by means of the satisfiability or validity of certain formulas in partial function logic. TAB

N70-39997# Parke Mathematical Labs., Inc., Carlisle, Mass.
ALGORITHMS FOR THE EVALUATION OF CERTAIN INTEGRALS APPEARING IN THREE-BODY PROBLEMS Final Report, Aug. 1967 – May 1970
Lorenzo Calabi Mar. 1970 75 p refs
(Contract F19628-68-C-0061)
(AD-707833; AFCRL-70-0243) Avail: NTIS CSCL 12/1

Algorithms are given for the evaluation of certain volume integrals needed for the bound state three-body problem. The techniques developed for the computation of residues have broad applicability. Author (TAB)

N70-39999# Wisconsin Univ., Madison. Mathematics Research Center.
SPLINE FUNCTIONS AND APPLICATIONS
T. N. E. Greville [1969] 106 p refs *Its* Orientation Lecture No. 8
(Contract DA-31-124-ARO(D)-462)
(AD-707620) Avail: NTIS CSCL 12/1

The document begins with a definition of a spline function, some general remarks about the nature and uses of such functions, an illustrative example, and a simple algebraic representation for any spline function. The important subclass of natural splines is defined in chapter 2 and the theorem of unique interpolation by natural splines and the well known minimal property of the smoothest interpolating natural spline is proven. Chapter 3 is concerned with the approximation of linear functionals. It includes Peanos theorem on remainders, A. Sards theory of best approximation of linear functionals, and I.J. Schoenbergs discovery that finding the best approximation to a given functional in Sards sense is equivalent to applying the functional to the corresponding natural spline interpolating function. Chapter 4 develops the properties of divided differences and of the B-splines, a special type of spline functions with limited support that constitute a basis for the class of spline functions and are important for computational purposes. Chapter 5 concerns a numerical algorithm for obtaining the natural spline interpolating function and also considers the smoothing natural splines resulting from Schoenbergs adaptation of E. T. Whittakers smoothing method. Author (TAB)

N70-40000# Stanford Univ., Calif. Dept. of Computer Science.
SECOND-ORDER MATHEMATICAL THEORY OF COMPUTATION
Zohar Manna Mar. 1970 28 p refs
(Contract ARPA SD-183; ARPA Order 457)
(AD-708077; SU-AIM-111) Avail: NTIS CSCL 12/1

The work shows that it is possible to formalize all properties regularly observed in (deterministic and non-deterministic) algorithms in second-order predicate calculus. Moreover, it is shown that for any given algorithm it suffices to know how to formalize its partial correctness by a second-order formula in order to formalize all other properties by second-order formulas. The result is of special interest since partial correctness has already been formalized in second-order predicate calculus for many classes of algorithms. Author (TAB)

N70-40001# Stanford Univ., Calif. Dept. of Computer Science.
AN INTERACTIVE THEOREM-PROVING PROGRAM
John Allen and David Luckham Oct. 1969 34 p refs
(Contract ARPA SD-183)
(AD-708074; SU-AIM-103) Avail: NTIS CSCL 12/1

The report presents an outline of the principle features of an on-line interactive theorem-proving program, and a brief account of the results of some experiments with it. The program has been used to obtain proofs of new mathematical results recently announced without proof in the Notices of the American Mathematical Society. Author (TAB)

N70-40007# Wisconsin Univ., Madison. Mathematics Research Center.
REGRESSION THEORY
Bernard Harris [1970] 92 p refs *Its* Orientation Lecture Series No. 7
(Contract DA-31-124-ARO(D)-462)
(AD-707619) Avail: NTIS CSCL 12/1

The chapter headings are the following: Linear regression and the principle of least squares; Stepwise regression; Nonlinear regression; Circumventing violations of the assumptions of linear regression theory. TAB

N70-40008# British Columbia Univ., Vancouver. Dept. of Mathematics.
THEORY OF ELLIPTIC BOUNDARY PROBLEMS Final Technical Report
Robert A. Adams, Bui An Ton, Colin W. Clark, and Charles A.

Swanson Jun. 1970 7 p refs
(Grant AF-AFOSR-1791-69)
(AD-708168; AFOSR-70-1819TR) Avail: NTIS CSCL 12/1

The report summarizes basic research results obtained in the theory of elliptic boundary problems. Contents include the following: Eigenvalue problems for singular elliptic operators; Embedding theorems; and Comparison and oscillation theory. TAB

N70-40013# Wisconsin Univ., Madison. Mathematics Research Center.
FIVE LECTURES ON THE NUMERICAL APPLICATION OF CONTINUED FRACTIONS
P. Wynn 1970 183 p refs *Its* Orientation Lecture Ser. 5
(Contract DA-11-022-ORD-2059)
(AD-707617) Avail: NTIS CSCL 12/1

In the first lecture the structure of the continued fraction is described and various ways of deriving continued fractions are discussed. The second lecture deals with a mechanism of convergence which includes the greater number of known continued fraction expansions. The third and fourth lectures are concerned with those continued fractions which (both for direct application in the calculation of functions and for their use in the acceleration of slowly convergent iterative processes) are of by far the greatest importance, namely continued fractions which are derived by the transformation of power series. The fifth lecture describes a number of formal procedures for transforming power series into continued fractions. It is shown how one of these methods may be used as the basis of a powerful technique for accelerating the convergence of iterative processes. TAB

N70-40025# Air Force Cambridge Research Labs., Bedford, Mass.
EIGENFUNCTIONS OF THE CURL OPERATOR, ROTATIONALLY INVARIANT HELMHOLTZ THEOREM, AND APPLICATIONS TO ELECTROMAGNETIC THEORY AND FLUID DYNAMICS
H. E. Moses May 1970 56 p refs *Its* Phys. Sci. Res. Papers No. 419
(AD-707825; AFCRL-70-0320) Avail: NTIS CSCL 12/1

Air Force Requirements, such as the knowledge of the upper atmosphere environment of vehicles and the knowledge of the propagation characteristics of radio and radar signals, require the solutions of the equations of motion of fluid dynamics and of electromagnetic theory which are often very complicated. This report presents a new mathematical approach to the obtaining of such solutions. The vector field is represented in such a form that new techniques may be used to find the appropriate solutions. Some problems of fluid dynamics and electromagnetic theory are solved as an illustration of the new approach. In this report, eigenfunctions of the curl operator are introduced. The expansion of vector fields in terms of these eigenfunctions leads to a decomposition of such fields into three modes, one of which corresponds to an irrotational vector field, and two of which correspond to rotational circularly polarized vector fields of opposite signs of polarization. Under a rotation of coordinates, the three modes which are introduced in this fashion remain invariant. Hence the Helmholtz decomposition of vector fields has been introduced in an irreducible, rotationally invariant form. These expansions enable one to handle the curl and divergence operators simply. As illustrations of the use of the curl eigenfunctions, four problems are solved. Author (TAB)

N70-40028# California Univ., Los Angeles. Numerical Analysis Research.
DIFFERENTIAL EQUATIONS ON CONVEX SETS
Michael G. Crandall 1970 24 p refs
(Contract Nonr-233(76))
(AD-707761) Avail: NTIS CSCL 12/1

Recent developments in the theory of semi-groups of non-linear transformations in Banach or Hilbert spaces have sharply brought into focus the fact that these theories must be developed for semi-groups on convex sets in order to achieve their full scope. The purpose of this note is to establish existence of solutions of a Cauchy problem of the form $du/dt = g(u,t)$, $u(0) = x$, where the function g is only defined on a set of the form $C \times (0,a)$ for some convex set C in a Banach space. The methods used are not new, but the main result seems to have gone unnoticed and serves to clarify some of the theory of semi-groups of nonlinear transformations and the related theory of accretive mappings in Banach spaces. Author (TAB)

N70-40044# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.
THE TWO-POINT BOUNDARY VERSION OF THE PROBLEM OF TWO BODIES
Andre Deprit May 1970 38 p refs
(AD-708170; D1-82-0975; Rept-6) Avail: NTIS CSCL 12/1

Hamilton-Jacobi's equation for the problem of two bodies in bipolar coordinates is solved in closed form; Stumpff's transcendental functions are used to express a complete solution of it in a universal form. This characteristic function is shown to be the source of the analytical expressions necessary to solve the two-point boundary version of the problem of two bodies. In particular, it establishes immediately Lambert's equation in its universal form. Author (TAB)

N70-40064# Wisconsin Univ., Madison. Mathematics Research Center.
EIGENVALUE PROBLEMS AND THEIR APPLICATIONS
Calvin H. Wilcox [1970] 61 p refs *Its* Orientation Lecture Ser. 3
(Contract DA-11-022-ORD-2059)
(AD-707610) Avail: NTIS CSCL 12/1

Eigenvalue problems have been studied intensively from the middle of the 18th century right up to the present, and there is a vast literature on them. The purpose of these lectures is to provide an orientation in this field, consisting of (1) A survey of the fundamental concepts and facts of the theory. (2) Discussion of some of the principal applications. (3) References for further study of the theory and its modern developments. Author (TAB)

N70-40065# Wisconsin Univ., Madison. Mathematics Research Center.
INTRODUCTORY LECTURES ON THE NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS
Donald Greenspan 1970 26 p refs *Its* Orientation Lecture Ser. 2
(Contract DA-11-022-ORD-2059)
(AD-707616) Avail: NTIS CSCL 12/1

Contents: Classification of partial differential equations of second order; Theoretical results for Laplaces equation; Theoretical results for the wave equation; Theoretical results for the heat equation; The need for numerical methods; Approximate solution of the Dirichlet problem; Approximate solution of the Cauchy problem; Approximate solution of problem H. TAB

N70-40074# Harry Diamond Labs., Washington, D.C.
METHOD FOR DETERMINING SHARED AND REPEATED ROOTS IN ALGEBRAIC EQUATIONS
Walter J. Brinks Apr. 1970 25 p refs
(AD-707927; HDL-TM-70-6) Avail: NTIS CSCL 12/1

Common roots shared among all the equations of a set of algebraic equations may be determined by pairing off the equations of the set and repeatedly subtracting, after certain preliminaries. Eventually, all the common roots may be found from an equation of degree equal to the number of common roots, which in many practical cases would be a linear relation or a quadratic. Multiple roots of a single equation, or shared in a set,

may be found in a similar manner. The method will also locate approximately the region of almost equal roots of two equations. The process is based on the nature of the roots of a polynomial, which is the algebraic sum of the given polynomials multiplied by constants. Author (TAB)

N70-40084# Stanford Univ., Calif. Dept. of Computer Science.
THE NEAR-MINIMUM-TIME CONTROL OF OPEN-LOOP ARTICULATED KINEMATIC CHAINS
Michael Edwin Kahn 10 Dec. 1969 183 p refs
(Contract ARPA SD-183)
(AD-708076; SU-AIM-106) Avail: NTIS CSCL 6/4

The time-optimal control of a system of rigid bodies connected in series by single-degree-of-freedom joints is studied. The dynamical equations of the system are highly nonlinear and a closed-form representation of the minimum-time feedback control is not possible. However, a suboptimal feedback control which provides a close approximation to the optimal control is developed. The suboptimal control is expressed in terms of switching curves for each of the system controls. These curves are obtained from the linearized equations of motion for the system. Approximations are made for the effects of gravity loads and angular velocity terms in the nonlinear equations of motion. Digital simulation is used to obtain a comparison of response of the optimal and suboptimal controls. The speed of response of the suboptimal control is found to compare quite favorably with the response speed of the optimal control. The analysis is applied to the control of three joints of a mechanical manipulator. Modifications of the suboptimal control for use in a sampled-data system are shown to result in good performance of a hydraulic manipulator under computer control. Author (TAB)

N70-40087# California Univ., Berkeley. Operations Research Center.
OPTIMAL DECISION IN QUEUEING
Houshang Sabeti Apr. 1970 63 p refs
(Contract DA-31-124-ARO(D)-331; N00014-69-A-200-1010)
(AD-708007; ORC-70-12) Avail: NTIS CSCL 12/2

A single server queueing system with Poisson arrival at rate lambda and a finite queue capacity N is considered. The service can be performed using one of K available service rates u1 = or < u2 = or < ... = or < uK. When service rate uk is in effect the service time is a random variable exponentially distributed with expected service time 1/uk, and a cost rate c(uk) is incurred. For each customer served, a reward of A will be earned. The problem is to choose service rate in order to minimize the expected discounted or expected long run average cost. The problem is formulated as a semi-Markov decision process with the state as the number of customers in the system. It is then shown that the optimal policy is switchover or reverse switchover depending upon whether or not the system is profitable. A switchover policy is a policy which uses higher rates in the higher states and a reverse switchover policy uses lower rates in the higher states. Author (TAB)

N70-40089# Wisconsin Univ., Madison. Mathematics Research Center.
THERE IS AN ELEMENTARY PROOF OF PEANO'S EXISTENCE THEOREM Technical Summary Report
Wolfgang Walter Jan. 1970 11 p
(Contract DA-31-124-ARO(D)-462)
(AD-707799; MRC-TSR-1037) Avail: NTIS CSCL 12/1

An elementary, constructive proof of Peanos existence theorem is given. The maximal solution is constructed as a limit of a decreasing sequence of approximate solutions. Author (TAB)

N70-40090# Wisconsin Univ., Madison. Mathematics Research Center.
MATRIX CHARACTERIZATIONS OF CIRCULAR-ARC GRAPHS Technical Summary Report
Alan Tucker Jan. 1970 19 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-707797; MRC-TSR-1026) Avail: NTIS CSCL 12/1

A graph G is a circular-arc graph if there is a 1-1 correspondence between the vertices of G and a family of arcs on a circle such that two distinct vertices are adjacent when the corresponding arcs intersect. Circular-arc graphs are characterized in terms of their adjacency matrix. Author (TAB)

N70-40106# Wisconsin Univ., Madison. Mathematics Research Center.
FUNDAMENTAL CONCEPTS AND PROBLEMS OF OPTIMAL CONTROL THEORY
L. C. Young 1970 81 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-707621) Avail: NTIS CSCL 12/1

The report contains a series of three introductory lectures, and one somewhat specialized lecture, on the mathematical theory of optimization for those control problems which concern systems with a continuously varying time. Author (TAB)

N70-40113# Michigan Univ., Ann Arbor.
PROOF OF A CONJECTURE BY A. W. BURKS AND H. WANG: SOME RELATIONS BETWEEN NET CYCLES AND STATES CYCLES
Bernard P. Zeigler May 1970 20 p refs
(Contracts DA-31-124-ARO(D)-483; N00014-67-A-0181-0011)
(AD-707955; Rept-03296-2-T; AROD-6499-22-M) Avail: NTIS CSCL 6/4

In a foundational paper on the theory of automata A. W. Burks and H. Wang (1957) conjectured that a certain complexity measure involving the size of the strong components of a logic net formed a hierarchy for net behavoir. A strengthened version of the conjecture is proved by establishing that any logic net can be interpreted as a series parallel composition of nets associated with its strong components. Some properties of the periodic behavior of machines, shown to be preserved under simulation and composition operations, are used to complete the proof. The relationship of this approach to algebraic proofs of series parallel irreducibility is discussed. Author (TAB)

N70-40130# California Univ., Los Angeles.
MULTIPLE SOLUTIONS OF A NONLINEAR ANALYSIS RESEARCH: NUMBERICAL ANALYSES RESEARCH
Michael G. Crandall and Paul H. Rabinowitz 1970 11 p refs
Prepared in cooperation with Wisconsin Univ., Madison
(Contracts N00014-69-A-0200-4022; Nonr-233(76)
(AD-707777) Avail: NTIS CSCL 12/1

The report contains a simplified proof of a recent result of Pimbley, as corrected by Parter, concerning the number of solutions of the Hammerstein integral equation u(x) = lambda the integral from 0 to 1 of K(x,y) H(y,u(y))u(y) dy for a given value of lambda. TAB

N70-40147# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
[ELECTROMAGNETIC DIFFRACTION THEORY, AND RADIATION FROM STATIONARY AND MOVING SOURCES] Final Report, 1 May 1961 – 14 Jan. 1970
Joseph B. Keller 14 Jan. 1970 26 p refs
(Contract Nonr-285(48))
(AD-708749) Avail: NTIS CSCL 20/14

The science of optics is founded on the fact that behavior of solutions of Maxwells equations simplifies in the limit of small wavelengths. Moreover, geometrical principles give valid qualitative information even for wavelengths comparable to typical dimensions of the objects involved. Although this has been known for many years, it is only recently that, starting with the work of Luneberg, these ideas have been made quantitative and they have been systematically pursued. The most successful extension of geometrical

optics is J. B. Kellers geometrical theory of diffraction, which now dominates the subject in both its practical and its theoretical aspects. Kellers methods are the mainstay of those concerned with scattering of electromagnetic waves by metallic objects. The bulk of the work on this contract has been devoted to refinement and extension of the methods of Luneberg and Keller. As a result of the work of Luneberg and Keller, with various extensions and modifications, methods are available to treat scattering by general bodies (smooth and convex, or with edges) and wave propagation and source problems in quite general media. These results can be applied in a great variety of situations, for example, to study waves in ionized media such as the ionosphere or the vicinity of reentry vehicles. These methods may also be used to study propagation of underwater acoustic waves and seismic waves. TAB

N70-40169# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.
ON MAXIMUM LIKELIHOOD ESTIMATORS OF SHAPE AND SCALE PARAMETERS AND THEIR APPLICATION IN CONSTRUCTING CONFIDENCE CONTOURS
Sam C. Saunders May 1970 29 p refs
(AD-708811; D1-82-0972; Rept-5) Avail: NTIS CSCL 12/1

In a paper by Thoman, Baine and Antle, it was shown that certain pivotal functions of the maximum likelihood estimators for parameters in the Weibull family have distributions which are parameter-free. By using Monte Carlo methods, this basic result made possible the production of tables of the percentile points of these distributions so that confidence intervals for the parameters can be determined. In turn this makes possible tests of hypotheses regarding the parameters. It is the purpose of this note to generalize this result in several respects. Firstly, to point out that for any given continuous distribution with support on the positive line and unknown shape and scale parameters the same pivotal functions of the maximum likelihood estimators are parameter-free. Secondly, that the same conclusion holds for incomplete samples censored under certain conditions or terminated at a given ordered observation. Author (TAB)

N70-40181# Kentucky Univ., Lexington.
TORSION FREE COVERING MODULES 2
Edgar E. Enochs [1970] 28 p refs Submitted for publication
Avail: NTIS

The purpose is to consider the relationship between the structure of E and that of T(E), characterize those A-linear mappings whose liftings are isomorphisms when A is a Dedekind domain, and compute T(S) when S is a simple module over a valuation ring. Author

N70-40191# Hawaii Univ., Honolulu.
DOMINANT STRATEGIES IN LINEAR PROGRAMS WITH VECTOR-VALUED COST FUNCTIONS
Rahul Chattopadhyay Apr. 1970 8 p refs
(Contract F44620-69-C-0030; Grant NSF GK-498416; Proj. Themis)
(AD-708148; THEMIS-A70-7; AFOSR-70-1790TR) Avail: NTIS CSCL 5/3

Problems of Linear Programming with Vector-Valued Cost Functions always admit non-inferior strategy solutions. However, dominant strategy solutions may not always exist. In some cases, the constraint set can be extended to include dominant strategies. TAB

N70-40192# Hawaii Univ., Honolulu.
DOMINANT STRATEGIES AND SUPER-LINEAR PROGRAMS WITH VECTOR-VALUED COST FUNCTIONS
Rahul Chattopadhyay May 1970 6 p ref
(Contract F44620-69-C-0030; Grant NSF-GK-4984; Proj. Themis)
(AD-708149; THEMIS-A70-8; AFOSR-70-1791TR) Avail: NTIS CSCL 5/3

The report presents a numerical method of obtaining dominant strategies in linear programs with vector-valued cost functions. The concept of a dominant strategy is also extended to super-linear programs with vector-valued cost functions. TAB

N70-40198# Kentucky Univ., Lexington.
TYPICALLY REAL POLYNOMIALS
W. C. Royster and T. J. Suffridge [1969] 10 p refs
Avail: NTIS

Let TR denote the class of normalized functions f analytic and typically real in the unit disk E. This paper initiates a study of polynomials P sub n(z) which belong to TR, that is, P sub n(z) is typically real in E. It is known that |c sub k| < or = to k, k = 2,3,.... For n < or = to 5 we find the exact bounds on a sub k, k < or = to n. Also obtained is the coefficient regions for the cubic and the odd polynomial. Author

N70-40199# Kentucky Univ., Lexington.
ON THE ZEROS OF FUNCTIONS WITH DERIVATIVES IN H SUB 1 AND H SUB INFINITY
James Wells [1969] 11 p refs Prepared in cooperation with Tex. Tech. Coll.
Avail: NTIS

Let |z sub k|, 0 < |z sub k| < 1, be a given sequence of points in the open unit disc D = |z : |z| < 1| and let E be its set of limit points on the unit circle T. Considered is the problem of finding conditions on the sequence |z sub k| which will ensure the existence of a function f analytic in D whose derivative f' belongs to the Hardy class H sub 1 or, alternatively, whose derivatives of all orders are bounded in D. Author

N70-40206# California Univ., Los Angeles. School of Engineering and Applied Science.
METHOD OF CONJUGATE GRADIENTS FOR OPTIMAL CONTROL PROBLEMS WITH STATE VARIABLE CONSTRAINT
Thomas Shu Fong Apr. 1970 102 p refs
(Contract F04701-69-C-0182; Grant-AF-AFOSR-699-67)
(AD-708125; UCLA-70-30; AFOSR-70-1775TR) Avail: NTIS CSCL 12/1

A review of the computational method of conjugate gradients for linear and nonlinear operator equations is given with emphasis in applying this technique to state variable constraint control problems. The first and second Frechet derivatives of the performance functional are derived. The search directions generated in the iteration process for the optimal control are locally conjugate with respect to the second Frechet derivative. The convergence is along the expanding sequence of sets, the intersections of the linear spaces spanned by the search directions and the set of admissible controls. The computational aspect of this class of control problems is discussed in detail. This computational technique is applied to two state variable constraint problems, in one of which a penalty function is employed to convert the constraint problem to an unconstrained one in addition to the approach considering the constraints directly. For this same problem the method of steepest descent also is studied, and comparison of the results obtained is made and discussed. Author (TAB)

N70-40221# Colorado State Univ., Fort Collins.
ON THE EXTENSION OF GAUSS-MARKOV THEOREM TO SUBSETS OF THE PARAMETER SPACE UNDER COMPLEX MULTIVARIATE LINEAR MODELS
J. N. Srivastava and Lyman McDonald Wright-Patterson AFB, Ohio ARL Mar. 1970 24 p refs
(Contract F33615-67-C-1436)
(AD-708165; ARL-70-0047) Avail: NTIS CSCL 12/1

The paper concerns the problem of linear estimation (without the assumption of normality) under certain general kinds of multiresponse linear models. These include the general incomplete multiresponse (GIM) model and its important special case, the

hierarchical multiresponse (HM) model, and also the multiple design multiresponse (MDM) model. These were considered in Srivastava (1967), where the general problem of obtaining the best linear unbiased estimate (BLUE) of general linear functions of the location parameters was investigated. The study is continued here in the direction of obtaining necessary and sufficient conditions for each of the above models to permit the existence of BLU estimates for all elements in a subset of the set of all estimate linear functions of the location parameters. Author (TAB)

N70-40224# Illinois Univ., Urbana. Coordinated Science Lab.
CODING THEOREMS FOR FILTERED-WAVEFORM CHANNELS
John Kingholm Moore Jun. 1970 224 p refs
(Contract DAAB07-67-C-0199)
(AD-708827; UILU-eng-70-220; R-475) Avail: NTIS CSCL 9/4

Filtered-waveform channels are continuous-time channels with waveform inputs satisfying a power constraint; the inputs are passed through a linear filter and corrupted by additive stationary Gaussian noise. Both a white-noise channel and a colored-noise channel with a matched filter are investigated. There exist equivalent channels (both of exactly the same form) which transmit coefficients of orthogonal expansions defined by the channel and are specified by its normal values. The direct half of the coding theorem is proved by Feinsteins fundamental lemma, using the asymptotic distributions of normal values and power distributions upon the input random variables. Weak and strong converses are proved. The capacity is also shown to be the supremum of asymptotic time-average mutual information over a class of stationary Gaussian inputs with spectral densities Orthogonal expansions in terms of normal functions in Hilbert spaces isometric to random signal and noise permit expression of mutual information in terms of normal values whose asymptotic distribution is found. The coding theorem is proved by random coding using the measure of the input process. Author (TAB)

N70-40250# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
PARAMETERIC ESTIMATION IN A DOUBLY TRUNCATED BIVARIATE NORMAL DISTRIBUTION
Danny D. Dyer (Ph.D. Thesis) 3 Apr. 1970 83 p refs
(Contract N00014-68-A-0515)
(AD-708669; THEMIS-SMU-TR-67) Avail: NTIS CSCL 12/1

When a target is rectangular and data are collected on the location of hits within the target area only, a truncated bivariate normal model will most often fit the data very well. An analysis is carried out of the estimation of the parameters of this distribution and computational procedures are devised for computing these estimates. In the process of these analyses approximations are obtained to functions which could be termed generalizations of Mills ratio. These ratios have applications in reactor technology. Author (TAB)

N70-40251# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
MINIMAL SUFFICIENT STATISTICS FOR THE GROUP DIVISIBLE PARTIALLY BALANCED INCOMPLETE BLOCK DESIGN (GD-PBIBD) WITH INTERACTION UNDER AN EISENHART MODEL 2
C. H. Kapadia and David L. Weeks (Okla. State Univ., Stillwater) 30 May 1970 20 p refs
(Contract N00014-68-A-0515)
(AD-708670; THEMIS-SMU-TR-69) Avail: NTIS CSCL 12/1

The paper exhibits a set of minimal sufficient statistics together with the distribution of each statistic in the set for the group divisible partially balanced incomplete block design with p replications per cell under the assumption that there is an Eisenhart Model 2 with interaction. The Rao- Blackwell theorem states that, if a minimum variance unbiased estimator exists, it must be an explicit function of the minimal sufficient statistics. It will be shown that the family of joint distributions of the minimal sufficient statistics is not complete, and so the question of existence of uniform minimum variance unbiased estimators is yet to be solved. Author (TAB)

N70-40271# Wisconsin Univ., Madison. Mathematics Research Center.
GENERALIZED SCHAUDER BASES
R. A. Tapia Dec. 1969 19 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-707796; MRC-TSR-1024) Avail: NTIS CSCL 12/1

An attempt is made to determine the most general classes of topological linear sapces such that each member contains one of the generalized Schauder bases, using three notions of generalized Schauder bases which have appeared in the literature. The results are fairly complete with respect to separable spaces and countable bases. TAB

N70-40282# Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics and Spatial Analysis.
GEOGRAPHY AND THE PROPERTIES OF SURFACES. THE DETERMINATION OF FIXED POINTS IN FINITE DIMENSIONAL SPACE Interim Report
C. Lindgren and S. Ernesto 3 Jun. 1970 19 p refs *Its* Theoret. Geography Ser. Paper No. 40
(Contract N00014-67-A-0298-0004)
(AD-707771) Avail: NTIS CSCL 12/1

L.E.J. Brouwers fixed-point theorem proves the existence of a fixed-point in a finite-dimensional space which is both convex and bounded, but provides no means of determining its position. For the case of a one-dimensional space, Marvin Shinbrot uses a graphical solution which can also be accepted as a proof for the theorem. This paper extends Shinbrots solution to any number of dimensions. Author (TAB)

N70-40290# Stanford Univ., Calif. Dept. of Computer Science.
THE USE OF DIRECT METHODS FOR THE SOLUTION OF THE DISCRETE POISSON EQUATION ON NON-RECTANGULAR REGIONS
J. Alan George Jun. 1970 24 p refs
(Contracts N00014-67-A-0112-0029; AT(04-3)-326; Grant NSF GJ-408)
(AD-708690; SU-STAN-CS-70-159) Avail: NTIS CSCL 12/1

Some direct and iterative schemes are presented for solving a standard finite-difference scheme for Poissons equation on a two-dimensional bounded region R with Dirichlet conditions specified on the boundary of R. These procedures make use of special-purpose direct methods for solving rectangular Poisson problems. The region is imbedded in a rectangle and a uniform mesh is superimposed on it. The usual five-point Poisson difference operator is applied over the whole rectangle, yielding a block-tridiagonal system of equations. Author (TAB)

N70-40291# Stanford Univ., Calif. Dept. of Computer Science.
AN ALGORITHM FOR FLOATING-POINT ACCUMULATION OF SUMS WITH SMALL RELATIVE ERROR
Michael Malcolm Jun. 1970 25 p refs
(Contracts N00014-67-A-0112-0029; AT(04-3)-326; Grant NSF GJ-408)
(AD-708691; SU-STAN-CS-70-163) Avail: NTIS CSCL 12/1

A practical algorithm for floating-point accumulation is presented. Through the use of multiple accumulators, errors due to cancellation are avoided. An example in Fortran is included. An error analysis providing a sharp bound on the relative error is also given. Author (TAB)

N70-40292# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
ON THE EQUIVALENCE OF PERTURBATION THEORY AND

THE BETHE-SALPETER EQUATION
Arthur R. Swift and Robin W. Tucker [1969] 8 p refs
Sponsored by NSF
Avail: NTIS

Polkinghorne's exact perturbation theory equation for the leading Regge trajectory resulting from an infinite sum of ladder diagrams is shown to be mathematically equivalent to the partial wave Bethe-Salpeter equation. Thus, the perturbation theory equation can be used not only for the leading Regge trajectory, but for all secondary trajectories as well. Author

N70-40293 Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
THE RISE AND FALL OF RELATIVISTIC TRAJECTORIES
Arthur R. Swift and Robin W. Tucker [1969] 49 p refs
Sponsored by NSF
Avail: NTIS

The general problem of rising and falling Regge trajectories is investigated in a fully relativistic model in which an arbitrary two particle interaction is unitarized by summing generalized ladder diagrams. The trajectories are extracted from the infinite sum by an extension of the technique previously applied to ladder diagrams in an ordinary scalar field theory. Any basic interaction which vanishes faster than any power of t, the momentum transfer, generates infinitely falling trajectories. A physical explanation of falling trajectories is given in terms of the scattering of infinitely composite particles where the standard single particle exchange interaction is modified by exponentially damped form factors. A variety of models for rising trajectories are constructed, all of which violate either the Jaffe bound on form factors or the Froissart bound on forward scattering amplitudes. Energy dependent interactions based on Regge pole exchange, energy dependent coupling constants, or direct form factors yield rising trajectories, but not narrow widths. Moreover, the energy dependence must be such that the Froissart bound appears to be grossly violated. Author

N70-40303# Douglas United Nuclear, Inc., Richland, Wash.
COMMERCIAL APPLICATION OF FAULT TREE ANALYSIS
P. A. Crosetti and R. A. Bruce 7 Apr. 1970 41 p refs Presented at the 9th Reliability and Maintainability Conf., Detroit
(Contract AT(45-1)-1857)
(DUN-SA-139; CONF-700702-1) Avail: NTIS

The potential for general application of fault tree analysis to commercial products appears attractive based not only on the successful extension from the aerospace safety technology to the nuclear reactor reliability and availability technology, but also because combinatorial hazards are common to commercial operations and therefore lend themselves readily to evaluation by fault tree analysis. It is concluded that the technique has application within the commercial industrial community where the occurrence of a specified consequence or final event would be of sufficient concern to management to justify such a rigorous analysis as an aid to decision making. Author (NSA)

N70-40314# California Univ., Los Angeles. School of Engineering and Applied Science.
STABILITY AND INSTABILITY, EXACT AND APPROXIMATE SOLUTIONS OF LINEAR DIFFERENTIAL EQUATIONS WITH TIME VARYING COEFFICIENTS
Alfonso Fred Ratcliffe Apr. 1970 88 p refs
(Grant AF-AFOSR-699-67)
(AD-708486; UCLA-70-45; AFOSR-70-1852TR) Avail: NTIS CSCL 12/1

The familiar soluble linear differential equations and the properties of linear systems are reviewed. The importance of linear differential equations and the origins of some such problems are discussed. The exact solutions of a class of second order differential equations and a more general class of nth order equations - those for which the fundamental solution matrix is composed of orthogonal vectors - are derived. A canonical form and the transformation, which leads to it, are derived and from this canonical form conclusions are drawn with respect to stability or instability using a modification of Liapounov stability theory. The canonical form dx/dt = (lambda + N)x where lambda is a diagonal matrix and N is an nxn skew symmetric matrix, is subsequently used to obtain approximate solutions to both homogeneous and nonhomogeneous linear differential equations. While the methods of this dissertation may theoretically be applied to an nth order linear system, in practice they are limited to second and third order systems unless machines are used. Author (TAB)

N70-40318# Texas Univ., Austin. Dept. of Mathematics.
APPROXIMATION THEORY AND FUNCTIONAL ANALYSIS
Final Report, 1 Jul. 1969 - 1 Jul. 1970
George G. Lorentz 1 Jul. 1970 11 p refs
(Grant AF-AFOSR-1826-69)
(AD-708487; AFOSR-70-1869TR) Avail: NTIS CSCL 12/1

The report describes research performed by the principal investigator in the following areas of approximation theory and functional analysis, restricted approximation, brickoff interpolation, problems, classical approximation, functional analysis and interpolation theorems. Author (TAB)

N70-40332# Stanford Univ., Calif. Dept. of Computer Science.
ESTIMATES OF THE ROUNDOFF ERROR IN THE SOLUTION OF A SYSTEM OF CONDITIONAL EQUATIONS
V. I. Gordonova Jun. 1970 20 p refs Transl. into ENGLISH from Zh. Vychisl. Mat. i Mat. Fiz. (USSR), v. 9, no. 4, Jul.-Aug. 1969 p 775-783
(Contracts N00014-67-A-0112-0029; AT(04-3)-326; Grant NSF GJ-408)
(AD-708692; STAN-CS-70-184) Avail: NTIS CSCL 12/1

The paper compares the roundoff error in the least-squares solution of a system of conditional equations Ax = f by two different methods, using backward error analysis. The first one entails solving the normal equations (A sup T)Ax = (A sup T)f and the second is one proposed by Faddeev, Faddeeva, and Kublanovskaya in 1966. This latter method involves multiplying the system by othogonal matrices to transform the matrix A into upper triangular form. Author (TAB)

N70-40335# California Univ., Los Angeles. School of Engineering and Applied Science.
ON THE IDENTIFICATION OF INERTIAL MEASUREMENT UNIT ERROR PARAMETERS
John Baziw (Ph.D. Thesis) Apr. 1970 218 p refs
(Contract F04701-69-C-0182; Grant AF-AFOSR-699-67)
(AD-708488; UCLA-70-32; AFOSR-70-1851TR) Avail: NTIS CSCL 12/1

The problem of identifying the error parameters associated with inertial measurement units is considered in this report. This is an important practical problem which is included in a large class of system parameter identification problems. A general approach for formulating the many possible inertial measurement unit (IMU) error parameter configurations is given, and specific realizations are specified in detail. The formulation is such that time correlated environmental and observational random disturbances can be incorporated. Experimental results showing the effects of state and observation noise power levels, and the nominal trajectory on the identification of the error parameters for three specific configurations are presented. These results indicate that a meaningful optimization problem can be formulated in terms of the nominal trajectory variables. The problem is then considered as an optimal control problem with the cost being a functional of the estimation covariance matrix and the controls, where certain nominal trajectory variables are considered as the controls. The question of the existence of optimal controls, the necessary conditions which the optimal controls must satisfy, and the computational aspects for computing the optimal controls are considered. Author (TAB)

N70-40336# Syracuse Univ., N.Y. Dept. of Physics.
STATUS OF CANONICAL QUANTIZATION
Peter G. Bergmann Jun. 1970 25 p Presented at Seminar on Relativity and Gravitation, Haifa, Israel, 15-17 Jul. 1969
(Grant AF-AFOSR-1654-69)
(AD-708490; AFOSR-70-1839TR) Avail: NTIS CSCL 20/10

Various approaches to canonical (local) quantization are related to each other, and their current status evaluated. Beginning with a review of Hamiltonian theory with first-class constraints this talk discusses Schrodinger quantization, Hamilton-Jacobi theory, with and without superspace, Feynman integrals, and the sandwich conjecture, and concludes with some speculations of a general nature. Author (TAB)

N70-40337# Syracuse Univ., N.Y. Dept. of Physics.
THE SANDWICH CONJECTURE
Peter G. Bergmann Jun. 1970 16 p refs
(Grant AF-AFOSR-1654-69)
(AD-708491; AFOSR-70-1840TR) Avail: NTIS CSCL 20/10

The Sandwich Conjecture (SC) was originally formulated by Wheeler and his coworkers. In the course of several years both the original author(s) and others have proposed the statement in several different forms, and with different qualifications. Roughly, the SC asserts that in a purely gravitational field the internal geometries of two distinct three-dimensional space-like hypersurfaces determines the geometry of a four-dimensional space-time (i.e. pseudo-Riemannian) manifold that is required to obey Einsteins field equations (i.e. to be Ricciflat). In a careful formulation one will have to specify further whether the two three-surfaces are to be close together, whether the distance between them is to be given as additional data, and what sort of conditions are to be imposed at space-like infinity. The SC is suggested by similar theorems that hold in classical mechanics, where knowledge of the configuration of a system at two distinct times may determine its trajectory throughout the period of time bounded by the two instants. If the SC were to hold, one would hope that the metric field can be quantized by Feynman integral methods. Quite apart from its bearing on quantization, the SC, and its possible limitations and qualifications, possesses considerable interest for the structure of Einstein manifolds per se. Author (TAB)

N70-40342# Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences.
RESEARCH IN METHODS OF NONLINEAR AND COMBINATORIAL PROGRAMMING Final Report
Leon Cooper [1970] 5 p refs
(Contract AT(11-1)-1493)
(COO-1493-37) Avail: NTIS

Progress is cited for investigations on: a transportation-location problem, an algorithm for solving integer linear programming problems, strategic risk and capital investment, methods of solving continuous constrained nonlinear programming problems, multidimensional piecewise polynominal curve fitting, dynamic programming and stochastic inventory control, the use of stationary policies in dynamic programming, obtaining exact optimal solutions more efficiently, and formulating objective functions and constraints in optimization problems. E.H.W.

N70-40357# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
ON THE APPLICATION OF THE METHOD OF DAS IN EVALUATING A MULTIVARIATE NORMAL INTEGRAL
John T. Webster 28 May 1970 11 p refs
(Contract N00014-68-A-0515)
(AD-708671; Themis-SMU-TR-71) Avail: NTIS CSCL 12/1

Das (1956) presented a method of evaluating Prob (x1 > a1 x2 > a2 ... xn > an) for a multivariate normal distribution which reduced the dimension of integration by the use of the univariate cummulative normal. This note investigates properties of the variance-covariance matrix that indicate how small this dimension of integration might be and presents a method of determining the coefficients for the expression of Das. Author (TAB)

N70-40360# Wisconsin Univ., Madison Mathematics Research Center.
EXTREMUM PRINCIPLES FOR THE EQUATION DEL SQUARED PHI EQUALS PHI-PHI CUBED
Peter D. Robinson Dec. 1969 22 refs
(Contract DA-31-124-ARO(D)-462)
(AD-707798; MRC-TSR-1032) Avail: NTIS CSCL 12/1

The Lagrangian functional G(phi) = the integral of ((1/2)phi(-(del squared)+1)phi -(1/4)(phi to the 4th power))dr is shown to be an upper bound for G(phi sub 0), where phi sub 0 is the ground-state eigen-function of -(del squared)phi + phi - (phi cubed) = 0, provided that G(phi) is stationary with respect to amplitude or scale variations in phi. Complementary functionals are also shown to provide upper bounds. Author (TAB)

N70-40385# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
MODEL AMPLITUDES CONTAINING ARBITRARY TRAJECTORIES, NONDEGENERATE DAUGHTERS AND DUALITY
Arthur R. Swift and Robin W. Tucker [1969] 10 p refs
Sponsored by NSF
Avail: NTIS

Model amplitudes are discussed which can accommodate nonlinear trajectories, satisfy duality and have a nondegenerate spectrum of daughter resonances. Author

N70-40386# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A PRACTICAL METHOD FOR OPTIMUM TRANSIENT RIDDANCE IN DAMPED LINEAR SYSTEMS
Phung khac Nguyen Jul. 1970 73 p refs
(Grant AF-AFOSR-1490-68A)
(AD-708826; UTIAS-TN-151) Avail: NTIS CSCL 22/1

The damping rate of a stable damped linear system can be defined as the negative of the real part of the eigenvalues which is closest to the imaginary axis. Consequently, the most rapid decay of transients can be achieved by selecting the design parameters in such a way that the damping rate is as large as possible. However, the discontinuity in the derivatives of the damping rate with respect to the design parameters, especially in the neighbourhood of its maximum, causes difficulty or even failure with the classical theory of maxima and minima, and other direct or indirect optimization methods. This problem is reformulated as an optimization problem wherein a function of several design parameters is maximized using a linear transformation of the eigenvalues in the complex plane and two Hurwitz criteria as constraints. The optimum damping rate and its associated design parameters are then the solution to a set of nonlinear, simultaneous, algebraic equations. A modified Newton-Raphson version in which a relaxation parameter is introduced and the inverse Jacobian matrix is approximated, is used for numerical solution. Two examples of second and fourth order systems are discussed. Author (TAB)

N70-40387# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON A CLASS OF SUBSET SELECTION PROCEDURES
Shanti S. Gupta and S. Panchapakesan Jun. 1970 24 p refs
/ts Mimeograph No. 225
(Contracts AF 33(615)67C-1244; Nonr-1100(26))
(AD-708754) Avail: NTIS CSCL 12/1

Let lambda sub i, i=1,...,k, be a continuous population with associated d.f. F sub (lambda sub i). (lambda sub i)epsilon lambda, an interval on the real line. The family (F sub lambda) is assumed to be stochastically increasing in lambda. Section 2 defines a class of procedures R sub h for selecting a non-empty subset of the k populations such that the probability of a correct selection (PCS).

i.e. selection of a subset which includes the population with the largest lambda sub i, is at least P^*, a pre-assigned level. A generalization (Theorem 2.2) of a result of a Lehmann is leading to the evaluation of the infimum of PCS over the parameter space. Results concerning the supremum of the expected subset size and other properties of R sub h form the content of the next section. Section 3 also contains more specific results when the density (F sub lambda)X is a convex mixture of a sequence of known density functions. The problem of selection of the population associated with the smallest lambda sub i is briefly discussed in Section 4. Author (TAB)

N70-40390# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
COMPETITIVE TWO-PERSON PERCENTILE GAME THEORY WITH DIRECT CONSIDERATION OF PAYOFF MATRICES
John E. Walsh and Grace J. Kelleher 11 Jun. 1970 21 p refs
(Contract N00014-68-A-0515)
(AD-708672; THEMIS-SMU-TR-72) Avail: NTIS CSCL 12/2

Considered is discrete two-person game theory where the players behave competitively and choose their strategies separately and independently. Payoffs can be of a very general nature and need not be numbers. Within each matrix, the payoffs can be ranked according to increasing desirability level. This is done separately by each player and these rankings are not necessarily related. Separately, player i, $\beta = 1,2$), selects and applies a percentile criterion 100ai to each matrix. A largest desirability level $P^*i(ai)$ occurs in the matrix for player i such that, when acting protectively, he can assure with probability at least ai that his payoff is at least this desirable (to him). Also, a smallest desirability level (Pj)(ai), according to the ranking by player i, occurs in the matrix for the other player (designated as j) such that player i, when acting vindictively, can assure with probability at least ai that the payoff to player j has at most this desirability (to player i). An ai-optimum solution occurs for player i when he can be simultaneously ai-protective and ai-vindictive. Median game theory occurs when $a1 = a2 = 1/2$. Percentile game theory occurs when more, or less, assurance is desired than occurs for the median case. Author (TAB)

N70-40396# California Univ., Irvine.
ON A CLASS OF OPERATORS IN HILBERT SPACE
Bernard R. Gelbaum [1970] 13 p refs Submitted for publication
(Grant NSF GP-13288)
Avail: Issuing Activity

An extension is made of the spectral theory to include a minimal algebra A and a useful topological space X so that the isometric *-isomorphism R sub T is approximately * C(X,A) which permits some analysis of T. Various aspects of a natural and fruitful generalization of the notation of commutative Banach algebra is discussed. Particular attention is given to a Q-uniform Banach algebra. E.H.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N70-39057# Bureau of Meteorology, Melbourne (Australia).
MONTHLY CLIMATE DATA: SURFACE, AUSTRALIA
Mar. 1970 43 p
Avail: NTIS

Climatological statistics most likely to meet the needs of commerce, education, primary and secondary industry, research and other fields are tabulated. The mean monthly data include pressure, cloud, temperature, sunshine, rain evaporation, and wind measurements for each district. Author

N70-39058# Bureau of Meteorology, Melbourne (Australia).
MONTHLY CLIMATE DATA: SURFACE, AUSTRALIA
Feb. 1970 44 p
Avail: NTIS

Climatological statistics most likely to meet the needs of commerce, education, primary and secondary industry, research and other fields are tabulated. The mean monthly data include pressure, cloud, temperature, sunshine, rain, evaporation, and wind measurements for each district. Author

N70-39059# Istituto di Fisica dell'Atmosfera, Rome (Italy).
PROPOSAL FOR OPERATIVE SYSTEM OF ITALIAN SATELLITES FOR METEOROLOGY OF THE MEDITERRANEAN [SISTEMA OPERATIVO DI SATELLITI ITALIANI PER LA METEOROLOGIA DEL MEDITERRANEO, PROPOSTA]
Maurizio Giorgi and Giorgio Fea Mar. 1970 24 p In ITALIAN
Avail: NTIS

A system composed of four satellites and a network of automatic-interrogation stations with a data acquisition and evaluation center is proposed for studying cyclogenesis and other meteorological phenomena in the Mediterranean. The meteorological parameters that the system must provide every three hours are listed, and the economic and international advantages of developing the system are discussed. Transl. by F.O.S.

N70-39183 Oregon State Univ., Corvallis.
MODELS FOR STATISTICAL DYNAMIC PREDICTION OF THE 500-MILLIBAR SURFACE
Robert Ross Fossum (Ph.D. Thesis) 1969 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-18352

Several stochastic process models for combined statistical dynamic prediction of the 500-millibar pressure surface for the Northern Hemisphere were constructed. To achieve this, a random forcing function is added to the spectral form of the nondivergent vorticity equation. Three models, one linear and two nonlinear are developed based upon the theory of stochastic ordinary differential equations. Mean value and covariance solutions to these equations are then found. Each model is converted to a difference equation and statistical estimation techniques suggested. The techniques are sufficiently general to be applied to simple multilevel models. Suggestions for extended range models and other areas of generalization are given. Dissert. Abstr.

N70-39289 Wisconsin Univ., Madison.
DYNAMIC CHARACTERISTICS OF THE SOUTHERN HEMISPHERE'S CIRCUMPOLAR VORTEX AND A COMPARISON WITH ITS NORTHERN HEMISPHERE COUNTERPART
Allen Ernest Staver (Ph.D. Thesis) 1969 121 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-12420

Conventional data is used to compare the two hemispheres' tropospheric circulation. Included are monthly mean zonal winds at levels from the surface up through 100 mb. Charts of eddy, mean motion and total kinetic energies are presented. Harmonic analyses of 500 mb monthly mean heights indicate that in the Southern Hemisphere only wave number one is important. Except in summer, the latitude belt near 50S exports westerly momentum toward both the equator and the South pole. In summer, that transport is reversed. In mid-latitudes of the Northern Hemisphere, wave numbers one and three transport westerly momentum poleward whereas the wave number two transport is equatorward. Slightly larger eddy kinetic energies in the Southern Hemisphere support a larger meridional heat transfer; therefore, the effect of the Antarctic continent as a heat sink must be even greater than the observed large latitudinal thickness gradient indicates. Dissert. Abstr.

N70-39318# Arizona Univ., Tucson.
INST. OF ATMOSPHERIC PHYSICS. METEOROLOGICAL FACTORS AFFECTING AIR POLLUTION
Benjamin M. Herman *In its* Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 91–100 (See N70-39313 22-04)
Avail: NTIS

Atmospheric motions are investigated as they relate to air pollution, with special reference to conditions in and around Tucson, Arizona. It is stated that clear skies and low humidity yield nocturnal temperature inversions, which favor the trapping of pollutants. Daytime heating, however, creates instability and favors vertical mixing of the air, thus dispersing pollutants vertically. Horizontal wind speeds and directions are considered. Factors important in determining atmospheric visibility are discussed; it is noted that any concentration of particulate matter reduces visibility when biased in a direction near the sun, and that often what appears to be a high local level of air pollution is merely an optical phenomenon. P.A.B.

N70-39356# Army Natick Labs., Mass. Earth Sciences Lab.
AREAL AND TEMPORAL OCCURRENCE OF HIGH DEW POINTS AND ASSOCIATED TEMPERATURES
Arthur V. Dodd Aug. 1969 251 p refs
(AD-707919; ES-49; USA-NLABS-TR-70-4-ES) Avail: NTIS CSCL 4/2

The report is a condensation of information currently available in the Earth Sciences laboratory concerning the frequency of occurrence of high dew points and the temperatures that are associated with high dew points. In the first section of the report, graphs showing the frequency of occurrence of high dew points and temperatures at 78 stations for the midseason months of January, April, July, and October are presented. Tables showing the maximum, minimum, and median temperatures associated with dew points above 75F supplement the information on the frequency graphs. This information is presented to illustrate the likelihood of occurrence of high dew points and high temperatures. In the second section of the report, maps showing the frequency of occurrence each month of dew points above 76F, 80F, and 84F at 215 stations between latitudes 40 N and 40 S are presented. Data for each station are presented on circular graphs, making possible quick comprehension of the seasonal pattern of occurrence of high dew points at the individual stations, and the inclusion of the circular graphs on the maps gives some insight into the areal distribution of the occurrence of high dew points. Author (TAB)

N70-39407# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 235 27 Aug. 1970 p 5–10 refs (See N70-39405 22-34)
Avail: NTIS

The managerial organization is discussed for the Soviet research program on global atmospheric processes. Working groups were established within this commission to study atmospheric circulation, formulating and checking mathematical models, and conducting numerical experiments on long range weather forecasts. The activities of a hail suppression investigation in the Crimean Peninsula are briefly reviewed. Abstracts on various meteorological literature are also included. J.A.M.

N70-39520# Stanford Univ., Calif. Dept. of Geophysics.
MICROBAROGRAPH STUDIES Annual Technical Report, 1 Apr. 1969–1 Apr. 1970
Jon F. Claerbout and Lee Lu 13 May 1970 45 p refs
(Contract F44620-69-C-0073; ARPA Order 1362-69)
(AD-707875; AFOSR-70-1689-TR) Avail: NTIS CSCL 4/2

Theoretical work included mathematical-computational simulation of an air wave propagating around the earth. The effect of horizontal variations of wind and temperature was included. These explain the severe defocussing always observed at the antipodes. Observational work included installation and operation of an LTV-LASA type microbarograph. Regular inspection of the records revealed a nuclear explosion and numerous incompletely understood meteorologic phenomena. Computer programs have been written and documented for reading LASA data tapes and Stanford data tapes. TAB

N70-39550# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
RADIATION REGIME OVER ARCTIC TUNDRA AND LAKE, 1966
Darrell F. Weaver May 1970 116 p refs
(Contract N00014-67-A-0103-0007)
(AD-707765; SR-6) Avail: NTIS CSCL 4/2

The radiative regime over both tundra and lake were measured in 1966 at the North Meadow Lake micrometeorology study site near Point Barrow, Alaska. The resulting data are of special interest because 1966 is considered climatologically normal, unlike the previously studied years, 1964 and 1965. Global radiation for 1966 was 324 kjoules per sq cm. Annual radiation totals over tundra and lake were, respectively, 175 and 161 kjoules per sq cm for reflected short-wave radiation, 100 and 101 kjoules per sq cm for net long-wave radiation, and 49 and 62 kjoules per sq cm for net total radiation. The average temperature for the year was -13.5C. The absolute minimum was -45.1C and absolute maximum 13.3C. The coldest month was March and the warmest July, with average temperatures of -31.4C and 2.9C, respectively. Hourly values of global short-wave radiation and net total radiation over tundra and lake are presented, along with daily averages or totals for cloud cover, air temperature, global short-wave radiation, net total radiation, reflected short-wave radiation, net short-wave radiation, and albedo. Monthly and annual sums are also tabulated. Author (TAB)

N70-39709# Army Foreign Science and Technology Center, Washington, D.C.
A METHOD OF DAMPING WIND SPEED
V. Yu. Torochkov 16 Apr. 1970 9 p refs Transl. into ENGLISH from Tr. Nauchn. Issled. Gidrometeorol. Priborostr. (USSR), no. 16, 1966 p 21–24
(AD-708320; FSTC-HT-23-679-70) Avail: NTIS CSCL 4/2

A gyroscopic method of damping a wind velocity sensor is discussed in this article. The wind receiver is the sensor of the M-27 anemometer. The article presents a numerical example which show that the method discussed provides a transient process time on the order of 600 seconds. Author (TAB)

N70-39852# Naval Research Lab., Washington, D.C.
DETECTION AND CHARACTERIZATION OF SURFACE ACTIVE MATERIAL IN THE MARINE ATMOSPHERE Interim Report
W. R. Barger and W. D. Garrett 26 May 1970 14 p refs
(AD-707713; NRL-7079) Avail: NTIS CSCL 8/10

Organic constituents of the marine atmosphere were collected on shallow trays exposed to onshore winds on the windward coast of the Island of Oahu. Upon addition of distilled water to the trays the collected materials formed monomolecular films on the water surface, and film pressure-vs-area curves for these films were determined at the field site. The monolayer studies indicated the presence of weakly surface-active organic compounds and hydrocarbons, as well as strongly adsorbed, highly polar species. Simultaneous collections of oceanic particulate matter were made with a high-volume air sampler using glass fiber filters. The organic material was extracted from the filters with chloroform and analyzed for specific fatty acids by gas chromatography. The ratios of the quantities of the principal fatty acids found in the air samples were similar to previously reported fatty acid ratios from sea surface samples which had been collected at the air/sea interface. It was concluded that the ocean appears to be a major source of airborne organic matter. The implications of these data to sea fog and haze stabilization are discussed. Author (TAB)

N70-39881# Illinois State Water Survey, Urbana.
MEASUREMENT OF THE SIMULATED RAINFALL AT THE HOLLOMAN TEST TRACK FACILITY Final Report, 1 Apr. 1969–31 Mar. 1970
Eugene A. Mueller and Arthur L. Sims Apr. 1970 37 p refs
(Contract F19628-69-C-0206)
(AD-707834; AFCRL-70-0282) Avail: NTIS CSCL 4/2

The results of measurements of the simulated rainfall at the Holloman test tract facility are presented. Raindrop spectra measurements were made with a drop camera and with an optical electronic drop spectrometer. A small amount of drop measurements using the flour pellet method were also made for comparison with the other methods. The measurements of the simulated rainfall were compared with average natural rainfall data collected with the drop camera. The average spectra from the track has a liquid water content of 7.96 g/m3 and an equivalent rainfall rate of 158.7 mm/hr. It does not correspond directly to any natural rainfall area. The natural rain data have been sorted into data from arctic, tropical, and temperate regions, and average raindrop spectra for various frequencies of occurrences calculated. Author (TAB)

N70-39902# Weather Wing (2nd), APO 332, New York.
FORECASTING REDUCED VISIBILITIES DUE TO ATMOSPHERIC AEROSOLS
Richard L. Walterscheid 1 Jun. 1970 7 p refs
(AD-708141; Rept-2WW-TN-70-2) Avail: NTIS CSCL 4/2

The problem of forecasting low visibilities has become less a problem of forecasting restrictions owing to condensed water droplets but rather has become more a problem of forecasting low visibilities owing to suspended particles. This paper discusses a formula and graph to calculate forecast visibility given initial conditions of visibility and relative humidity. Author (TAB)

N70-39920# Naval Postgraduate School, Monterey, Calif.
A STUDY OF ATMOSPHERIC FRONTOGENESIS WITH THE PRIMITIVE EQUATIONS
Richard Reuben Hadfield (M.S. Thesis) Apr. 1970 53 p refs
(AD-708390) Avail: NTIS CSCL 4/2

The deformation of an unstable baroclinic wave as a result of mean horizontal wind shear is studied with the use of a five-layer primitive equation model. Two basic wind profiles were tested: (1) uniform zonal flow, (2) jet type zonal flow. The jet profile produced a cold front and a warm front, with the warm front being the more intense. The uniform zonal flow produced a cold front. The cold fronts were produced by horizontal shearing deformation fields and the warm front was produced by horizontal stretching deformation fields. The formation of the warm front was also enhanced by strong horizontal convergence. The occlusion process was not observed in the experiments. Author (TAB)

N70-40131# Naval Weather Service, Washington, D.C.
SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS, NORTH AMERICAN COASTAL MARINE AREAS. VOLUME 2: AREA 4 BOSTON, AREA 5 QUONSET POINT, AREA 6 NEW YORK, AREA 7 ATLANTIC CITY
May 1970 642 p
(AD-707699) Avail: NTIS HC $10.00/MF $0.65 CSCL 4/2

The report is part of a series of compilations which is regional in scope. It consists of climatological and air-sea interface data in tabular form for specified water areas adjoining Boston, Quonset Point, New York and Atlantic City. Author (TAB)

N70-40132# Naval Weather Service, Washington, D.C.
SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS, NORTH AMERICAN COASTAL MARINE AREAS. VOLUME 3: AREA 8 NORFOLK, AREA 9 CAPE HATTERAS, AREA 10 CHARLESTOWN
May 1970 486 p
(AD-707700) Avail: NTIS CSCL 4/2

The report is part of a series of compilations which is regional in scope. It consists of climatological and air-sea interface data in tabular form for specified water areas adjoining Norfolk, Cape Hatteras, and Charleston. Author (TAB)

N70-40133# Naval Weather Service, Washington, D.C.
SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS, NORTH AMERICAN COASTAL MARINE AREAS. VOLUME 4: AREA 11 JACKSONVILLE, AREA 12 MIAMI, AREA 13 KEY WEST
May 1970 487 p
(AD-707701) Avail: NTIS CSCL 4/2

The report is part of a series of compilations which is regional in scope. It consists of climatological and air-sea interface data in tabular form for specified water areas adjoining Jacksonville, Miami, and Key West. Author (TAB)

N70-40138# Naval Postgraduate School, Monterey, Calif.
GENERAL CIRCULATION EXPERIMENTS WITH A TWO-LEVEL QUASI-GEOSTROPHIC MODEL INCLUDING THE NON-LINEAR INTERACTON BETWEEN A SINGLE WAVE IN THE ZONAL DIRECTION AND THE MEAN FLOW
Frank H. Taylor (M.S. Thesis) Apr. 1970 47 p refs
(AD-708385) Avail: NTIS CSCL 4/2

A long-period forecast is made using a two-level quasi-geostrophic model. The model includes friction and heating which is a linear function of y. The model was further simplified by restricting the disturbance to one wave in the zonal direction. Experiments were performed with two distances between the walls. In the case of the longer separation, a solution with appreciable time fluctuations was obtained with the largest fluctuation being investigated in more detail. The smaller separation revealed a traveling wave of constant amplitude similar to that observed in certain dishpan experiments. Author (TAB)

N70-40148# Weather Science, Inc., Norman, Okla.
AN EVALUATION OF PROCEDURES AND TECHNIQUES USED DURING CLOUD PUFF 3 Final Report, 15 Mar. 1969–15 Mar. 1970
Hoyt E. Hart, D. Ray Booker and Joe L. Sutherland 1 Jun. 1970 115 p refs
(Contract F19628-69-C-0239)
(AD-708752; WR002; AFCRL-70-0283) Avail: NTIS CSCL 4/2

Cloud Puff III was a joint-services research effort in cold cumulus seeding. AFCRL participants placed primary emphasis on searching out and testing new methods appropriate to aircraft-oriented field research in cloud modification. Under separate contract each of the various procedural aspects involved in the preparation, execution, and postoperational phases of the Cloud Puff III project has been examined in detail. A field data laboratory has been designed and equipped, and computer programs have been written for each of the aircraft mission functions. TAB

N70-40243# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
THERMAL CONVECTION BETWEEN SLOPING PARALLEL BOUNDARIES
John E. Hart (Ph.D. Thesis) Apr. 1970 204 p refs
(Contract AF 49(638)-1493)
(AD-708185; AFOSR-70-1747TR; Rept-70-101A) Avail: NTIS CSCL 4/2

The effect of sloping boundaries on thermal convection is studied theoretically and experimentally in the context of a model in which fluid is contained in a differentially heated rectangular box of small aspect ratio (depth/length), inclined at an angle to the vertical. Like its two limiting cases, Benard convection and convection in the vertical slot, there is a steady laminar two-dimensional mean flow at low Rayleigh numbers which becomes unstable. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N70-39305*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SSS-A ETU ATTITUDE AND SPIN CONTROL SUBSYSTEM MAGNETIC TESTS
J. C. Boyle May 1970 26 p
(NASA-TM-X-65323; X-325-70-237) Avail: NTIS CSCL 17G

The small scientific satellite attitude and spin control subsystem was installed in the engineering test unit spacecraft and tested in the spacecraft magnetic test facility during the period January 6–8, 1970. The subsystem was tested in both the spin-up and spin-down modes, at the nominal spin rate of 4 rpm as well as at 2 rpm and 6 rpm. With 0 bias, the threshold for full turn-on and for full turn-off was found to be 8100 gammas. The magnetic moment developed by the spin-control coil was 2600 pole-centimeters. Data were also taken in the attitude control mode. A magnetic moment of 9673 pole centimeters was developed. It was demonstrated that this moment remained on over the whole cycle from the field levels of 7500 gamma and up at a rotational speed of 4 rpm. Author

N70-39607*# International Business Machines Corp., Gaithersburg, Md.
INSTRUMENT LANDING SYSTEMS FOR THE SPACE SHUTTLE
Herbert P. Raabe *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 73–90 (See N70-39603 22-31)
Avail: NTIS CSCL 17G

The terminal flight characteristics of the returning space shuttle are described and the requirements for an instrument landing system ILS derived. The presently available systems are reviewed and their deficiencies to serve the shuttle are pointed out. The effort of the special committee of the Radio Technical Commission for Aeronautics is reported. This effort consists of defining future requirements for aircraft ILS's, screening proposed techniques for their potential in meeting these requirements and establishing a common waveform. The requirements for space shuttle and aircraft landing operations are compared. An ILS concept potentially capable of meeting shuttle and aircraft requirements is described. Author

N70-39736# Coast Guard, Washington, D.C.
RADIO NAVIGATION APPLICATIONS WITHIN THE U. S. MARITIME COMMUNITY. NATIONAL PLAN FOR NAVGATION
1970 376 p
(AD-707878) Avail: NTIS CSCL 17/7

The study was accomplished as an input to the Coast Guard Aids to Navigation Study and concurrently as background from which the Coast Guard may participate in the development of a joint FAA/USCG/DOD position regarding total U. S. needs and systems. The latter position, upon concurrence of the three agencies, may then be published as the National Plan for Navigation when approved by the Secretary of Transportation. Based on that plan, the methodology suggested in this study for budget support, on-going system development recommendations, and the identified areas of potential need, the Coast Guard may then develop its own long range plan in implementation of those facets of the National Plan for which it is responsible. Author (TAB)

N70-39778# Louisiana State Univ., Baton Rouge. Dept. of Electrical Engineering.
A MINMAX STUDY OF AIM ANGLE FOR PROPORTIONAL NAVIGATION MISSILE (THE PLANAR CASE)
Glenn Paul Orgeron (M.S. Thesis) May 1970 186 p refs
(Contract F44620-68-C-0021)
(AD-708167; AFOSR-70-1808TR) Avail: NTIS CSCL 16/4

The problem of minimizing the maximum terminal miss of a planar case, proportional navigation missile attacking a high performance aircraft by optimally selecting missile launch angle is studied. System models are developed for both the aircraft and the missile; constraints are introduced to preserve physical realism. An algorithm based upon a worst-case error analysis is applied to find the optimum missile launch angle. Recurring patterns have been found for target and missile control over the area of interest. Effects of variations in missile velocity, missile time constant, and proportional navigation constant have been observed. Author (TAB)

N70-39790*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL DIVISION
In its Space Programs Sum. No. 37–63, Vol. 3 30 Jun. 1970 p 80–123 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 17G

Radiant interchange factors and gamma ray effects of radioisotope thermoelectric heaters were analyzed and absolute gamma intensities from plutonium-228 and its daughters were calculated. Optical approach navigation data from television images of the Mariner Mars mission were processed and produced good estimates for spacecraft trajectories. The reliability of a digital attitude autopilot was evaluated for spacecraft guidance and control purposes. A cesium-free photo-electric emitter was constructed for the electrostatic image dissector, and a baseline digital inertial reference unit for thermoelectric spacecraft attitude control was developed. G.G.

N70-40057# Naval Postgraduate School, Monterey, Calif.
A SHORT RANGE PRECISE NAVIGATION SYSTEM
Peter Elmer Palm (M.S. Thesis) Dec. 1969 82 p refs
(AD-708387) Avail: NTIS CSCL 17/7

A precise short-range relative navigation system is proposed to provide repeatable position-determining capability of uniform accuracy over the entire area of coverage. It is a continuous-wave phase comparison system, which derives range information from the change in phase between stable oscillators as the distance between them is varied. The transmitters and their associated controls were designed to implement a prototype system. Considerations necessary in the development of the system receiver are discussed based on tests conducted on the transmitters. Author (TAB)

N70-40129# Naval Research Lab., Washington, D.C.
PRECIPITATION EFFECTS ON OMEGA AIRCRAFT RECEIVERS Final Report
R. L. Eisenberg 18 May 1970 29 p refs
(AD-707710; NRL-7055) Avail: NTIS CSCL 17/7

Omega is a very-low-frequency (vlf) radio navigation system characterized by very long range and an accuracy on the order of 1 to 2 mi with respect to earth coordinates. Early flight tests of Omega aircraft receivers using vertical electric-field antennas achieved excellent results in good weather but experienced almost constant signal loss in precipitation conditions. Signal losses appeared to be caused by precipitation static and shorting of the insulation at the bases of the antennas. Modifications of vertical antennas, including shielding of the leading edge and improved base insulators, reduced but did not solve the problem. An experimental NRL-designed-and-constructed crossed-loop antenna system improved reception characteristics with respect to both wetting and static pickup. NRL has evaluated the performance of modified vertical antennas and crossed-loop antennas in the laboratory and on Omega test flights. These flight tests have revealed that the

crossed-loop antenna offers adequate sensitivity and a significant reduction of precipitation effects and thus provides all-weather operation of Omega aircraft receivers. Author (TAB)

N70-40141# Palmer (Winslow), Babylon, N.Y.
PROPOSAL FOR STANDARD TIME AND FREQUENCY BY OMEGA
Winslow Palmer Dec. 1969 206 p
(Contracts N00024-67-C-1416; N00024-67-R-3446)
(AD-707070; OMEGA-TN-17) Avail: NTIS CSCL 17/7

Because it necessarily provides a highly-stable worldwide radio signal field with a format adapted to ready determination of the phase of the signals of at least three stations anywhere on earth, the OMEGA Radio Navigation and Position Locating System is inherently a world wide source of Standard Time and Frequency of exceptional quality. There is no essential conflict between the use of OMEGA for position locating and as a source of Time and Frequency. The same receiving equipments can be utilized for either purpose with no modification. As presently being implemented, the OMEGA Signal Format can be tracked to yield a continuous 24 hour-a-day Standard of Time and Frequency anywhere on earth, with a phase variation of the order of a few microseconds RMS, or better; but does not, however, yield an unambiguous epoch of time without initial setting. A completely unambiguous time service could be provided in the OMEGA Signal Format, with minimal impact on all present navigation equipments, by lowering the RF Frequencies by 0.75% (0.0075 per unit) and adding two additional components to the Multiplex Pattern. It is recommended that the OMEGA Radio Signal Field be adopted as a WORLD STANDARD TIME, and that the development of the OMEGA System as a source of Time and Frequency be continued. Author (TAB)

N70-40158# Naval Research Lab., Washington, D.C.
MEASURING FIELD INTENSITY OF OMEGA SIGNALS WITH TRACOR 599R OMEGA RECEIVER
W. D. Meyers Apr. 1970 14 p refs
(AD-707071; NRL-MR-2129) Avail: NTIS CSCL 17/7

Omega is a long-range, very-low-frequency, hyperbolic radio navigation system. Coverage for the entire earth will be provided by eight transmitters which transmit on the same frequencies on a time-sharing schedule. Each station transmits for approximately one second on 10.2 kilohertz (kHz), one second on 13.6 kHz, and one second on 11-1/3 kHz in a sequence such that only one transmitter is transmitting on a particular frequency at any given time. The sequence repeats every ten seconds. The field intensity measurement of an Omega transmission is difficult to make due to the low-duty cycle of the transmission and to the high atmospheric noise level. A system for measuring the field intensity of Omega signals was developed using a Tracor Omega receiver, M DEL %(IR, and a calibrated loop antenna, the details of which are given in this report. Author (TAB)

N70-40160# Palmer (Winslow), Babylon, N.Y.
MEAN PHASE GEOMETRY IN THE OMEGA SYSTEM Final Report
Winslow Palmer Oct. 1969 84 p refs
(Contracts N00024-67-C-1416; N00024-67-R-3446)
(AD-707069; OMEGA-TN-16) Avail: NTIS CSCL 17/7

In addition to the usual intersection of hyperbolic contours, geographic position can also be determined in OMEGA by advancing an assumed position to make the computed offset from the mean of the distances from three or more stations agree with the offsets from the mean of the phases of the signals from those stations. Plotting of position is essentially similar to reduction of celestial data, and the process inherently establishes an absolute clock time to within microseconds, so that a precision oscillator is NOT required on the vehicle. In Mean Phase Geometry, the phase tracking loops of the receiver follow velocity and acceleration with respect to the stations, directly, so that rate aiding, or OMEGA-Inertial Hybrid operation can be provided simply by resolution of air-mass or inertially derived velocities into components relative to the stations. The mean phase offsets must be corrected for diurnal shift and for earth oblateness, etc, and data from the newer Skywave Correction Tables, giving corrections for each path independently, can be used directly. Author (TAB)

N70-40253# California Univ., Los Angeles. School of Engineering and Applied Science.
ON THE OPTIMUM UTILIZATION OF INERTIAL COMPONENTS
Eugene Chin Hoy (Ph.D. Thesis) Apr. 1970 106 p refs
(Contract F04701-69-C-0182; Grant AF-AFOSR-699-67)
(AD-708479; Rept-70-24; AFOSR-70-1849TR) Avail: NTIS CSCL 17/7

A variety of problems dealing with the optimum utilization of inertial sensors is discussed. Inertial sensors, i.e., accelerometers and gyroscopes, play an important role in determining the overall performance of a system using inertial navigation. The performance of an inertial system is determined not only by the basic characteristics of the individual sensors, but also by the manner in which the sensors are employed. For example, the orientation of the sensors with respect to the trajectory, and the trajectory itself determine what effects the sensor errors will have on the system performance. Direct analytical solutions to the optimum orientation problems are desired to provide fresh insights into the situation and to supplement existing orientation guidelines. Methods of most effectively utilizing redundant data are desired. Both ballistic and cruise inertial systems are considered. To facilitate the obtaining of direct analytical solutions, accuracy criteria and error models are established that are not only significant but are conducive to obtaining analytical solutions as well. For optimum orientation problems, analytical expressions are first derived for the accuracy criteria in terms of the orientation parameters. Then, the orientation parameters that optimize these criteria are found. Similarly, the most mathematically tractable forms are selected for the examination of redundant sensors, and the study of the feasibility of trajectory shaping to minimize measurement errors. Author (TAB)

N70-40338# Army Foreign Science and Technology Center, Washington, D.C.
PROBLEMS OF INVESTIGATION OF COMPOSITE GYROMOTORS ACCELERATED BY A SOLID FUEL ACCELERATOR [NEKOTORYYE VOPROSY ISSLEDOVANIYA KOMBINIROVANNYKH GIROMOTOROV S RAZGONOM OT POROKHOVYKH USKORITELEY]
Yu. M. Kravchenko et al 15 Apr. 1970 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (USSR), v. 10, no. 12, 1967 p 57-62
(AD-708492; FSTC-HT-23-480-70) Avail: NTIS CSCL 17/7

The article is devoted to an investigation of the conditions and characteristic features of operation of gyromotors with impulse starting and electrical maintenance of a constant kinetic moment. The results of the experiment can be used when calculating gyromotor designs for various application conditions. Author (TAB)

N70-40341# Naval Postgraduate School, Monterey, Calif.
EVALUATION AND UPDATING OF LORAC NAVIGATION SYSTEM ON MONTEREY BAY
Andrew Franklin Durkee (M.S. Thesis) Dec. 1969 73 p refs
(AD-709089) Avail: NTIS CSCL 17/7

A LORAC system of navigation has been established in the Monterey Bay area and is intended for use in the field of ocean sciences research. It operates on a phase comparison principle and provides highly accurate navigational fixes without complex timing circuitry. Short-term phase stability of the system was studied and methods of remote control and lane identification were investigated. Some equipment modifications were made to incorporate desirable features in the system, but further modernization may be necessary

if long periods of continued use are expected. A general plotting program for the CALCOMP-563 plotter was written to produce chart overlays for existing navigational charts and is included as Appendix B. The overlays can be tailored to fit any scale chart in the area of intended operation and the inputs to the grid generation program can be varied if the system parameters are changed.
Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N70-39025# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE APPLICATION OF IMAGE ENHANCEMENT TO FFTF FUEL TECHNOLOGY
B. R. Hayward May 1970 57 p refs
(Contract AT(45-1)-1830)
(BNWL-1321) Avail: NTIS

Current technical data analysis and evaluation methods are reviewed. Image enhancement is one of the advanced methods which is in the preliminary stages of application to nuclear technology. Interest in these systems lies in the extraction of more data from standard negatives than is presently obtained. Application of these techniques to earth sciences, medicine, and space technology has already been demonstrated. Typical types of application to fuel work include X-rays, neutronradiographs, autoradiographs, electron diffraction patterns, and photomicrographs.
Author (NSA)

N70-39026# Westinghouse Electric Corp., Large, Pa. Astronuclear Lab.
COBALT-60 HEAT SOURCE DEMONSTRATION PROGRAM, PHASE 1 Preliminary Analysis and Design Technical Report
C. Kim Aiken, S.C. AEC Jan. 1970 286 p refs
(Contract AT(38-1)-543)
(WANL-543-1) Avail: NTIS

Activities in the Phase 1 preliminary analysis and design effort on the Cobalt-60 heat source demonstration program for the period from March 1969 to December 1969 are summarized. The major objectives of the Phase 1 effort were to perform parametric analyses of factors influencing the heat source performance, versatility, scalability, size, weight, and cost to investigate the practicability of the out-of-hot-cell heat source operation, to develop preliminary design of the cobalt-60 heat source system, and to develop a conceptual design of the transportable refueling cask system.
NSA

N70-39027# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PROMETHIUM ISOTOPIC POWER DATA SHEETS
J. H. Jarrett and H. H. Van Tuyl May 1970 50 p refs
(Contract AT(45-1)-1830)
(BNWL-1309) Avail: NTIS

The nuclear, physical, mechanical, and chemical properties of promethium metal and promethium oxide are summarized. The projected availability of promethium is given and summary information on containment materials, together with summary information on promethium applications are included.
Author (NSA)

N70-39032# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
SODIUM TECHNOLOGY DEVELOPMENT PROGRAM MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS Quarterly Progress Report, Dec. 1969 – Feb. 1970
Apr. 1970 22 p refs
(Contract AT(04-3)-180)
(GEAP-13539-12; QPR-12) Avail: NTIS

The number of materials studies has been extended to include cladding candidates for oxide fuel (Types 304, 316, and 347 stainless steels (SS), and Incoloy 800). The temperature range of testing has been increased to 1300 F, and temperature profiles loop geometry, and sodium purity controls have been established to represent environments of large fast reactors in an improved way. Increasing emphasis has been placed on improving sodium impurity monitoring and control. In-line devices are used to obtain rapid and, where possible continuous indications of impurity changes. These include chromatography for cover gas, replaceable flow-through sodium samplers electrochemical cells for oxygen activity and diffusion cells for hydrogen concentration in sodium. Provisions are being made for electrochemical cells for carbon. Cold traps for control of sodium purity in test loops have been modified with electromagnetic stirring devices to increase cleanup rate and automatic controls are being added for continuous and unattended operation.
NSA

N70-39033# Gulf General Atomic, San Diego, Calif.
APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS Quarterly Progress Report, 1 Oct. – 31 Dec. 1969
R. L. Bramblett, R. O. Ginaven, T. Gozani, J. I. McMillan, G. M. Reynolds et al 30 Jan. 1970 46 p refs
(Contract AT(04-3)-167)
(GA-9943) Avail: NTIS

The development of nondestructive measurement techniques for nuclear materials in the various forms encountered in the nuclear reactor fuel cycle are summarized. Aspects of the program on which significant progress was made during the reporting period are described. The projects include the low sub-MeV neutron technique; barrel scanning-data analysis; threshold photoneutrons from U-235; fission products gamma spectra for U-235, Pu-239, Th-232 and U-238; neutron yield calculations; and a transportable assay system.
NSA

N70-39043# Gulf General Atomic, San Diego, Calif.
APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS Quarterly Progress Report, 1 Jul. – 30 Sep. 1969
R. L. Bramblett, R. O. Ginaven, T. Gozani, L. A. Kull, J. I. McMillan et al 28 Nov. 1969 58 p refs
(Contract AT(04-3)-167)
(GA-9871) Avail: NTIS

Developments in equipment and techniques for the nondestructive assay of nuclear materials are summarized. The projects described include barrel assay, a digital computer system, a linac sub-MeV neutron technique, threshold photoneutron measurements, a computer code for the analysis of gamma-ray spectra, energy calibration and resolution determination for the 270 deg magnet system, a transportable assay system, and scanner system X-ray shielding.
NSA

N70-39083# Los Alamos Scientific Lab., N.Mex.
Pu 238 SPACE ELECTRIC POWER FUEL DEVELOPMENT PROGRAM Quarterly Status Report, 1 Oct. – 31 Dec. 1969
6 Apr. 1970 38 p refs
(Contract W-7405-eng-36)
(LA-4419) Avail: NTIS

Continuing studies have demonstrated the capability of forming Pu-238 O2 containing solid solution cermets (SSC). Work during the previous quarter was primarily oriented toward procuring and installing proper equipment and toward establishing a process which would produce SSC material of the specified composition and power densities. The process flow sheet employed yields SSC fuel

with the desired properties. Other studies have been in progress to characterize this fuel form and enough data have been obtained from these examinations to draw of such Pu-238 02-Th02-Mo cermet in the specified form of a 2.14 in. dia disk was achieved during this quarter. A schematic representation of such a standard disc is shown. NSA

N70-39100# Oak Ridge National Lab., Tenn.
SYMPOSIUM ON SOL-GEL PROCESSES AND REACTOR FUEL CYCLES
May 1970 584 p refs Symp. held at Gatlinburg, Tenn., 4-7 May 1970
(CONF-700502) Avail: NTIS

The conference proceedings are divided into 7 sections and include 38 papers. The sections are: reactor fuel cycles, fuel element and process design using sol-gel systems, sol-gel processes for fuel preparation, fabrication processes for sol-gel fuels, performance of sol-gel fuels, fundamental studies, and supplement. NSA

N70-39107# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
A SUMMARY OF TUBE FABRICATION STUDIES USING PLANETARY SWAGER
C. G. Collins Jun. 1970 27 p refs
(Contract AT(4)-1)-2847)
(GEMP-744) Avail: NTIS

The capabilities of the planetary swager were to determine the feasibility of its use in the fabrication of clad fuel pins for fast breeder reactors. The operating principles of the swager are outlined together with observations of its capacity relative to tube wall thickness, reduction per pass, and draw speed as applied to four austenitic stainless steels. An empirical procedure for predicting deformation parameters of a material worked in the swager is also described. It is concluded that fuel pins can be fabricated from commercial tubing provided the starting tube size is selected within the swager's capacity. Author (NSA)

N70-39109# Oak Ridge National Lab., Tenn.
OPERATING EXPERIENCE AND DESIGN TRENDS FOR HELIUM-COOLED NUCLEAR POWER REACTORS
D. B. Trauger Jun. 1970 24 p refs Presented at the Helium Soc. Symp., Washington, D.C., 23-24 Mar. 1970
(Contract W-7405-eng-26)
(ORNL-TM-2946; CONF-700316-1) Avail: NTIS

Operating experiences for the Peach Bottom Power Reactor Unit 1, AVR, Dragon, and Los Alamos Turret Reactor are reviewed. Design trends for helium cooled power reactors are presented. NSA

N70-39113# Oak Ridge National Lab., Tenn.
THE DISTRIBUTION OF FISSION PRODUCT TRITIUM IN A ZIRCALOY-CLAD UO2 BLANKET ROD FROM PWR-1
J. H. Goode and C. M. Cox Jun. 1970 30 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2994) Avail: NTIS

The given Zircaloy-2-clad UO2 blanket rod was irradiated to 3.41% FIMA at a time-averaged linear heat rate of 4.84 kW/ft, with a clad temperature of 259 C, for the full life of the first core of the Shippingport Pressurized Water Reactor. It was destructively examined to determine the distribution of fission product tritium. There was apparently no loss of tritium from the rod; 7% of the yield of tritium was found in the Zircaloy metal cladding (apparently as the tritide) and 93% in the UO2 fuel. Author (NSA)

N70-39121# Atlantic Richfield Hanford Co., Richland, Wash. Separations Chemistry Lab.
COULOMETRIC DETERMINATION OF PLUTONIUM IN SOLUTIONS OF DISSOLVED REACTOR FUEL ELEMENTS
G. S. Barney Jan. 1970 13 p refs Presented at the 159th Natl. ACS Meeting, Houston, Tex., 22-27 Feb. 1970
(Contract AT(45-1)-2130)
(ARH-SA-55; Conf-700201-2)

Controlled-potential coulometry was applied to the determination of plutonium in complex, highly radioactive mixtures of U, Pu, Np, and fission products that result from the dissolution of reactor fuel elements in nitric acid. It was found that a separation of Pu from fission products was necessary prior to the titration because of the poisoning effect of Zr on the working electrode and the significant concentrations of fission product elements with oxidation potentials close to that of the Pu(III)/Pu(IV) couple. A strongly-basic anion exchange resin containing pyridinium exchange groups was used in small (9 cm × 0.5 cm) columns for the separations. The separation procedure gave better than 99% recovery of Pu and resulted in the elimination of significant concentrations of interfering ions. The measured radiation of the sample was also reduced from an average of 3 r/hr to about 150 mr/hr. Coulometric analysis of 7 Pu samples resulted in a relative standard deviation of + or- 1.1% at the 95% confidence interval. Author (NSA)

N70-39129# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
BOREAL: A PILE FOR TESTING BORON CONTENT OF ALUMINUM - BORON ALLOY SAMPLES [EMPILEMENT "BOREAL" POUR LE CONTROL DE LA TENEURE EN BORE D'ECHANTILLONS D'ALLIAGE ALUMINUM-BORE]
Jean-Claude Carre and Christian Letour Mar. 1970 28 p refs in FRENCH
(CEA-N-1284) Avail: AEC Depository Libraries

The basis and the description of the measurement assembly BOREAL are given and the first results are reported. BOREAL is a small graphite array containing a neutron source. It is intended for testing the boron or absorber content of small slabs, for instance aluminum-boron alloy slabs. With appropriate reference samples the absolute boron or absorber content can be determined. In the case of testing made for instance on samples containing 400 ppM of boron enriched at 90 per cent in B-10, corresponding to 14 mg of boron, the statistical accuracy of a single measurement of 2000 sec is about 8 ppM (2 percent). Author (NSA)

N70-39133# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
WELDING STAINLESS STEEL FUEL ELEMENT END PLUG ENCLOSURES
R. C. De Klever, W. R. Jacoby, and R. K. McGeary Feb. 1970 29 p refs
(Contract AT(30-1)-4135)
(WARD-3791-44) Avail: NTIS

Liquid metal fast breeder reactor fuel elements typically consist of thin wall (circa 10 mils) stainless steel tubing containing uranium-plutonium ceramic fuel pellets. A TIG welding process was developed and used to fabricate experimental irradiation pins containing (U,Pu)C fuel immersed in sodium which required welding large stainless steel plugs inserted into the tube ends. Although this method has been adopted and applied by many laboratories, it is prone to the formation of defects attributable to nonuniform tube metal melting and solidification. Development results from solution annealed and 20% cold worked AISI 316 tubing are presented. Discussion centers around the types and causes of the random defects that may occur for extensively refined procedures and equipment. The merits of various undestructive and destructive testing methods for weld quality are presented. The importance of scrupulous adherence to parts dimensions, fitup, electrode configuration and positioning, and control of other process variables is illustrated. Author (NSA)

N70-39134# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Power Generation Dept.
REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM

May 1970 34 p refs Revised
(BAW-10006-Rev-1) Avail: NTIS

The reactor vessel material surveillance program is designed to provide information on reactor vessel material nil-ductility transition temperature (NDTT) changes caused by neutron irradiation. The program is for the 850-MW(e) class of reactors of similar design and power level. Data obtained from all of the vessels surveyed in the program can be integrated and applied to any vessel so long as the fabrication procedures and the designs are comparable. The program is applicable to all future plants of similar design if the geometry and the type of vessels used are the same and if the pressure vessel steel treatment is the same. NSA

N70-39139# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
REPROCESSING OF IRRADIATED PLUTONIUM AND URANIUM MIXED OXIDES [LE TRAITEMENT DES OXYDES MIXTES DE PLUTONIUM ET D'URANIUM IRRADES]
P. Faugeras 1969 34 p refs In FRENCH Presented at the 2d Spanish-French Symp. on Fuel Reprocessing and Plutonium Chem., Madrid, Nov. 1969
(CEA-Conf-1534; Conf-691122-3) Avail: AEC Depository Libraries

A study was made on the cost of reprocessing as a function of capacity for the irradiated mixed oxides UO2–PuO2. An amortization rate of 11% corresponding to a period of 17 years and to a rate of interest of 8% was considered. Several possible improvements to be made on the Purex process in order to reduce the reprocessing cost were studied. These are continuous shearing and dissolution; reduction in the number of extraction cycles for the separations of U from Pu; simplification of the conditioning operations of U and Pu; automation and automatic chemical control, and rational treatment of fission product solutions. The use of a volatilization process should reduce the cost of processing. Small plant units associated with one or several reactors on the same site seem to be still profiting-earning, because of the elimination of transfer and the reduction of plutonium investment. Author (NSA)

N70-39141# California Univ., Livermore. Lawrence Radiation Lab.
FUSION POWER: DIRECT CONVERSION AND THE REDUCTION OF WASTE HEAT
R. F. Post [1970] 16 p
(TID-25414) Avail: NTIS

Fusion reactors are discussed in the context of the direct conversion of fusion energy to electricity. The use of particles released from fusion reactors for the purpose of direct conversion is discussed. The use of different fuels and different conversion cycles is also discussed. NSA

N70-39152# United Kingdom Atomic Energy Authority, Harwell (England).
KINETICS OF FISSION-FRAGMENT YIELD DURING CHANGES OF REACTOR POWER
B. V. Samsonov et al Aug. 1969 12 p refs Transl. into ENGLISH from the Russian
(AERE-Trans-1122) Avail: AEC Depository Libraries

The phenomenon of the activity burst of fission products emerging from the fuel composition at a sharp reactor power increase is investigated. This activity burst is explained by the changes of neutron flux, temperature and the diffusion coefficient of fragments. Calculations and experimental results are given. The calculated data are in agreement with experiments. Author (NSA)

N70-39158 Utah Univ., Salt Lake City.
COMPUTER AIDED ANALYSIS OF NUCLEAR REACTOR KINETICS
Simon Abraham Vreeke (Ph.D. Thesis) 1969 270 p
Avail: Univ. Microfilms: HC $12.15/Microfilm $3.50 Order No. 69-18668

A computer aided technique using an interactive graphics system is used to examine nonlinear point nuclear reactor kinetics problems. From the graphical output displayed on the CRT terminal the general solution of any system of autonomous differential equations whose solutions are amenable to a geometric interpretation in phase space can be studied. The canonical formulation is utilized in order to obtain the most informative projection planes for third order systems. Concepts concerning stability of the actual formulation of a mathematical model and its solutions are examined. Various nuclear reactor kinetics models of both second and third order are analyzed for reactivities which are either functions of temperature or xenon. The effects of delayed neutrons are included by using a constant effective generation time a function of reactivity and its derivative. Dissert. Abstr.

N70-39163# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
PERFORMANCE OF PLUTONIUM-URANIUM MIXED-OXIDE FUEL PINS IRRADIATED IN A FAST REACTOR (EBR-2) TO 50,000 MWd/Te
R. C. Nelson, W. E. Baily, R. N. Duncan, C. N. Spalaris, and E. L. Zebroski Aug. 1969 114 p refs
(Contract AT(04-3)-189)
(GEAP-13549) Avail: NTIS

Twelve encapsulated mixed-oxide fuel pins were irradiated in the EBR-2 fast reactor core to about 50,000 MWd/t burnup. These fuel pins were part of a study to investigate various fuel pin design parameters. Fuel pin performance was evaluated by extensive post-irradiation examinations. Eleven of the fuel pins, clad with Type 316 or 347 stainless steel, remained intact. One fuel pin, F2F, clad with Incoloy-800, failed, probably as a result of a defective weld. The eleven intact pins were found to be in excellent condition with a maximum of about 0.001 inch cladding distortion. Details of the examination and additional results are reported. Author (NSA)

N70-39172# Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.
ENVIRONMENTAL INFLUENCES ON FUEL BURNUP IN MK. 3 GCR'S. PART 1: EQUILIBRIUM SITUATION (CONTINUED). PART 2: EFFECTS OF CONTROL RODS
P. R. Ainger Feb. 1970 47 p refs
(RD/B/N-1550; M-3-RPC/P-101) Avail: AEC Depository Libraries

The properties of fuel in two particular reactor situations are studied. An equilibrium HTR core is simulated by a non-leaking supercell. Comparisons are made between these results and the zero-leakage edit of the corresponding WIMS output. Environmental effects, in the form of 9-group bucklings as a function of irradiation, are derived from the supercells and used to constrain a further WIMS burnup. It is found that the changes in characteristics between these two runs are significant at any point in time, but small when averaged over life. The recycled data are then put into the supercells and the change observed is insignificant. Fuel close to a grey control rod is also investigated. A cylindrical supercell model is used and gives a hardened spectrum near the rod, which is reflected in a considerable change of properties of the fuel. It appears that a 2-group calculation is incapable of representing this situation adequately. Author (NSA)

N70-39173# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.
STATISTICAL METHOD FOR DETERMINATION OF SUBCRITICALITY OF FAST REACTORS
H. W. Glauner and G. Heusener Jan. 1970 10 p In GERMAN
(KFK-1148) Avail: AEC Depository Libraries

For the determination of the subcriticality of a fast reactor, a method is investigated to measure and evaluate an artificially produced flux-asymmetry in the core. A neutron source is inserted in an asymmetric core position and the resultant neutron flux will

be measured at two locations. As the flux-ratio of the two measurements is dependent on the subcriticality, it can be used to determine subcriticality. The advantage of the method is its simplicity, as there are no additional installations besides the normal flux detectors necessary. Author (NSA)

N70-39180# Battelle-Northwest, Richland, Wash.
DATA ACQUISITION FOR FUEL FABRICATION
A. W. DeMerschman 20 Nov. 1969 7 p Presented at the 17th Conf. on Remote Systems Technol., San Francisco
(Contract AT(45-1)-1830)
(BNWL-SA-2686; CONF-691102-23) Avail: NTIS

Installation of an SEL 10188 data acquisition system for inventory and criticality control of enriched fissile materials at the Fast Flux Test Facility is reported. The system provides a data storage and rapid retrieval capability for process use and quality control. NSA

N70-39196# Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires.
AIR FLOW CONTROL DEVICE IN THE RAPSODIE REACTOR TERMINAL EXCHANGERS
Florent Bouras and Jacky Rion Feb. 1970 15 p In FRENCH
(CEA-N-1263) Avail: AEC Depository Libraries

This device controls the position of the electro-pneumatic regulator of the Rapsodie reactor terminal sodium-air heat exchangers, taking into account the input temperature of the cooling air. The required reliability and maintainance led to a very simple design. Author (NSA)

N70-39244# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
INTERIM BURST TEST RESULTS ON EBR-2 IRRADIATED FUEL PIN SECTIONS
R. L. Fish, J. J. Holmes, and R. D. Leggett Apr. 1970 23 p refs
(Contract AT(45-1)-1830)
(BNWL-1323) Avail: NTIS

Burst tests were conducted at 900 F on specimens prepared from 75% UO2–25% PuO2 fuel pins clad with Type 304 stainless steel that were irradiated in EBR-2 to approximately 8000 MWd/Mtm at 8 to 9 kW ft. Specimens taken from the midplane but within the fuel column exhibited brittle, integranular fracture at drastically lower stresses (approximately 30,000 psi). Fueled specimens from below the midplane and specimens from the fission gas plenum exhibited a ductile, transgranular fracture at stresses and strains normally expected. Post-test examination of the burst test specimens included diameter measurements, optical metallography, electron microscopy, and shielded electron microscopy, and shielded electron microprobe analysis. Fueled specimens from above the midplane contained M23C6 and sigma phase at the grain boundaries of the cladding whereas the cladding of specimens from below the fuel midplane were free of grain boundary precipitates. Author (NSA)

N70-39255# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
SEPARATION NOZZLE DEMONSTRATION PLANT FOR URANIUM ENRICHMENT
E. W. Becker et al [1969] 8 p refs Transl. into ENGLISH from Atomwirtsch., Atomtech. (Duesseldorf), v. 14, May 1969 p 249–251
(NP-TR-1884) Avail: AEC Depository Libraries

In order to make more accurate economic evaluations of the separation nozzle method, development and design studies were undertaken for a pilot plant with a separation output of 600,000 kg U/yr. The plant would supply light water reactors with a total capacity of 6000 MW(e) continuously with fuel. It would cost approximately 300 million DM and consume about 10% of the current produced. It was calculated that the investment costs and the current consumption could be reduced significantly by additional development work. A prototype of the nozzle stages proposed for the pilot plant is under construction. NSA

N70-39259 Carnegie-Mellon Univ., Pittsburgh, Pa.
CRYSTALLINE BINDING EFFECTS ON REACTOR PHYSICS PARAMETERS
William Arthur Weinreich, III (Ph.D. Thesis) 1969 192 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-19113

Crystalline binding effects on reactor physics parameters are determined for reactor systems in which beryllium oxide is the moderator. The accuracy of the crystalling binding representation needed to properly account for crystalline effects is also determined. The incoherent approximation is made for both elastic and inelastic scattering of neutrons. The differential scattering cross section is expressed in terms of the scattering law formalism. Lattice dynamics models for beryllium oxide are analyzed. Scattering kernels are calculated for three models chosen to represent the crystalline binding. These three models are the effective temperature gas model, the lattice dynamics model of Debye, and the modified shell model used to calculate the phonon frequency spectrum of beryllium oxide. Preliminary investigations are made to determine the adequacy of these models for representing the scattering properties of beryllium oxide. Dissert. Abstr.

N70-39286# Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany).
REGULATIONS FOR THE HANDLING AND THE WORK WITH SOURCES OF IONIZING RADIATION
Dec. 1969 34 p refs In GERMAN
(SZS-18/69) Avail: AEC Depository Libraries

Included are a compilation of regulations and standards in the field of radiation protection legal in the G. D. R., the Ordinance on Licensing of Nuclear Plants in full text, and a paper on damages caused by radioactive substances or by the operation of nuclear plants with regard to insurance problems. NSA

N70-39267# Institutt for Atomenergi, Halden (Norway).
HBWR Quarterly Progress Report, Jan.–Mar. 1970
May 1970 98 p refs Supported by Various Natl. Atomic Energy Agencies
(HPR-124; QPR-36) Avail: AEC Depository Libraries

The research and developments at the Halden Boiling Reactor are reported. Topics include the development of a digital computer for the reactor control system, and the radiation testing of zircaloy clad uranium oxide. F.O.S.

N70-39323# Argonne National Lab., Ill. Chemical Engineering Div.
ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 14: PROCESSING EXPERIENCE IN FLUORINATING PLUTONIUM MATERIALS AND THERMALLY DECOMPOSING PLUTONIUM HEXAFLUORIDE IN THE ENGINEERING-SCALE ALPHA FACILITY
N. M. Levitz, G. J. Vogel, E. L. Carls, I. E. Knudsen, D. E. Grovenor et al Nov. 1969 119 p refs
(Contract W-31-109-eng-38)
(ANL-7473-Pt-14) Avail: NTIS

The applicability of fluoride-volatility methods to the reprocessing of light-water-reactor fuels was demonstrated in a program of fluid-bed fluorination studies and fluid-bed thermal-decomposition studies conducted in an engineering-scale alpha facility. Studies were conducted on nonirradiated UO2–PuO2–F.P. pellet materials and PuF4 powder charges. Key features of this work were the production and transport of PuF6, and the demonstration of good plutonium material balances. The

results of these studies are considered applicable to processes for high-plutonium materials, such as fast-breeder-reactor fuels and plutonium scrap materials. Author (NSA)

N70-39333# Gulf General Atomic, San Diego, Calif.
APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS Quarterly Progress Report, 1 Jan. – 31 Mar. 1970
R. L. Bramblett, R. O. Ginaven, T. Gozani, G. D. Trimble, and D. E. Rundquist 31 Mar. 1970 41 p refs
(Contract AT(04-3)-167)
(GA-10106) Avail: NTIS

The development of nondestructive methods and equipment for measurement of nuclear materials in the various forms encountered in the nuclear reactor fuel cycle are summarized. The methods and equipment being developed are oriented toward those which use electron accelerators for the interrogating source. Progress is reported on the construction of a transportable assay system for nuclear materials in bulk samples, barrel scanning, and the timing sub-MeV assay method. Information is also presented on photoinduced neutron yields and fission product gamma-ray yields. NSA

N70-39346# Institute of Nuclear Research, Warsaw (Poland).
DETERMINATION OF STATIC MACROPARAMETERS FOR WWR-SM LATTICES WITH INCREASED WATER-TO-FUEL RATIO
L. Adamski, E. T. Josefowicz, K. Josefowicz, and K. Kowalska 1969 50 p refs
(INR-1152) Avail: AEC Depository Libraries

Critical water-moderated and reflected cores consisting of WWR-SM fuel elements and water channels were studied. Two kinds of lattices were considered, differing by the pattern of water channels and by the water-to-fuel ratio in the core. Macroscopic lattice parameters and neutron distributions were measured and calculated. Both calculational and experimental methods are described and the calculated and measured quantities are presented together with the discussion of possible sources of errors. Author (NSA)

N70-39366# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
LIMITING CRITICAL CONCENTRATIONS OF PLUTONIUM-URANIUM SOLUTIONS AND MIXTURES
D. W. Magnuson 20 May 1969 5 p refs
(Contract W-7405-eng-26)
(Y-DR-17) Avail: NTIS

Calculations using the ANISN transport code were performed in the S4 approximation using the Hansen–Roach cross-section sets appropriate to the scattering cross section per atom for the U and Pu isotopes for the limiting critical concentrations for various plutonium–uranium fuels at several H: U atom ratios. The results of the calculations are summarized tabularly. NSA

N70-39389*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NEUTRON KINETICS OF A FAST, HOT, CRITICAL ASSEMBLY IN THE STARTUP MODE
George F. Niederauer Washington Sep. 1970 45 p refs
(NASA-TM-X-2078; E-5289) Avail: NTIS CSCL 18K

A reactor for auxiliary power in space has been designed using (U-235)N fuel in a tantalum structure with Li–7 coolant. The kinetics of a hot critical assembly of the same design with and without coolant has been parametrically studied in the startup mode to determine safe operating ranges of ramp reactivity inputs. The main parameters considered were wide ranges in the magnitudes of the Doppler and thermal expansion reactivity coefficients and several kinds of expansion effects. Author

N70-39420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUXILIARY AND LOOP FOR REMOVAL OF DECAY HEAT FROM A SPACE POWER REACTOR
George E. Turney and Edward J. Petrick Washington Sep. 1970 33 p
(NASA-TM-X-2077; E-5579) Avail: NTIS CSCL 18L

An auxiliary radiator loop with sodium coolant was investigated as a possible means for removing decay heat from a proposed 2.17-megawatt space power reactor. Based on a selected set of operating conditions and assumptions, minimum areas were determined for the auxiliary loop heat exchanger and radiator. The minimum auxiliary heat exchanger surface area was determined to be 0.64 sq ft (0.594 sq m), and the minimum auxiliary radiator surface area was 37.7 sq ft (3.50 sq m). Based on these areas, the maximum temperature of the auxiliary radiator was about 1760 R (978 K). The flow rates and temperatures of sodium in the auxiliary loop were determined as a function of time after reactor shutdown for reactor operating times of 1 year and 1 day. A significant conclusion from the preliminary study is that the size (and/or mass) of the auxiliary loop is relatively small. Author

N70-39428# Scottish Research Reactor Centre, East Kilbride.
ANALYSIS OF THE Xe 135 CONCENTRATION IN CYCLICALLY OPERATED NUCLEAR REACTORS
J. A. Riley and J. Scobie Sep. 1969 23 p refs
(SRRC-32/69) Avail: AEC Depository Libraries

The detailed theoretical solution for the core Xe-135 concentration in nuclear reactors working on a cyclic basis is presented. Also included are copies of the Fortran 5 computer programs used to evaluate the final solution for the different cycle times, operation times, and neutron flux levels assumed. Author (NSA)

N70-39430# Idaho Nuclear Corp., Idaho Falls.
CHEMICAL DEVELOPMENT FOR EBR-2 FUEL PROCESS, 1967 – 1969
B. C. Musgrave, ed., R. G. Butzman, T. L. Evans, M. E. Jacobson, L. C. Lewis et al Apr. 1070 35 p refs
(Contract AT(10-1)-1230)
(IN-1285) Avail: NTIS

The laboratory development work done at Idaho Chemical Processing Plant for the electrolytic dissolution process for EBR-II fuels is summarized. Topics reported include fuel storage, dissolution, characterization of the solid residues resulting from electrolytic dissolution, solvent extraction of uranium from the dissolver product solutions, and corrosion of materials of construction. Author (NSA)

N70-39434# Atomic Energy Commission Research Establishment. Lucas Heights (Australia).
INFLUENCES OF RADIATION ON THE OXIDATION OF ZIRCONIUM ALLOYS IN HIGH TEMPERATURE WATER. EXAMINATION OF THEIR BEHAVIOUR IN SUPERHEATED STEAM . [INFLUENCE DU RAYONNEMENT SUR L'OXYDATION DES ALLIAGES DE ZIRCONIUM DANS L'EAU A HAUTE TEMPERATURE. EXAMEN DE LEUR COMPORTEMENT DANS LA VAPEUR SURCHAUFFEE]
J. Blanchet Jun. 1970 15 p refs Transl. into ENGLISH from Bull. Inform. Sci. Tech. (Paris), no. 139, Jul.–Aug. 1969 p 47–58 In ENGLISH and FRENCH Presented at Nucl. Corrosion Days, Paris, 12–13 Dec. 1968; sponsored by Centre for Tech. Improvement
(LIB-Trans-245) Avail: NTIS

A description is given of the corrosion behavior of Zircaloy-2 fuel element cans in various water-cooled reactors and which have been in operation for several years. A review is made of certain research projects designed to study the effects of irradiation on the corrosion of zirconium alloys. It appears certain that only fast neutrons enhance the corrosion, and this is to an extent which depends on the flux intensity and on the oxygen content of the water. The most important research concerning the development of

zirconium alloys for use in superheated steam is reviewed. Several alloys have, in this medium, a much better corrosion resistance than Zircaloy-2. Author (NSA)

N70-39440# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
EXPERIMENTS ON CENTRIFUGAL EXTRACTORS [EXPERIMENTATION D'EXTRACTEURES CENTRIFUGES]
M. Tarnero 1969 13 p refs In FRENCH Presented at the 2d Spanish-French Symp. on Fuel Reprocessing and Plutonium Chem., Madrid, 17-19 Nov. 1969
(CEA-Conf-1536; Conf-691122-4) Avail: AEC Depository Libraries

A set of experiments on uranium extraction and reextraction conditions was performed on a centrifugal extractor. Raffinates containing U from 0.1 to 0.5 mg X 1 sup −1 could be obtained easily from uranium inputs of 90 and 180 X 1 sup −1. An undesirable effect of an increase in the rotational speed and a good effect of an increase in the total flow rate were observed. With inputs equal to 400 g X 1 sup −1, the stages were tightened in order to reduce the leaks that cause charged aqueous phases to pollute the raffinates. These leaks become more significant when the rotataional speed increases but could be reduced by using the extractors of large diameter. An excess amount of reductor was found to be necessary in the reducing reextractions of cerium(IV). The hydrodynamic behavior was satisfactory with flow-rate ratios of solvent to aqueous phase up to 29. But the plutonium extractions should be more significant. Experiments were also made on precipitate formation from fission zirconium and from solvent degradation products. Only a small amount of precipitate was found to discharge into the aqueous phase; a larger amount was accumulated in the extractor. Author (NSA)

N70-39445# International Atomic Energy Agency, Vienna (Austria).
STANDARDIZATION OF RADIOACTIVE WASTE CATEGORIES
1970 18 p refs Held at Vienna, 6-10 Nov. 1967
(STU/DOC-10/101) Avail: AEC Depository Libraries

In order to develop more uniform international standards for the classification of radioactive wastes, the present of waste classification is reviewed, and proposals are made for defining specific categories of gaseous, liquid, and solid wastes. The categories are based on the radioactivity concentration for liquid wastes, the radiation dose on the surface of the waste for solid wastes, and the radioisotope content of gaseous wastes. NSA

N70-39465# Scottish Research Reactor Centre, East Kilbride.
[SCOTTISH RESEARCH REACTOR CENTER SESSIONS] Annual Report, Oct. 1968 – Sep. 1969
H. W. Wilson Jan. 1970 19 p refs
(SRRC-37/70) Avail: AEC Depository Libraries

Research projects, reactor operations, and educational programs are reviewed for October 1968 to September 1969. NSA

N70-39510# Sandia Corp., Albuquerque, N.Mex.
USE OF SOLUTIONS TO THE ADJOINT TRANSPORT EQUATION FOR THE EVALUATION OF RADIATION SHIELD DESIGNS
James H. Renken Jan. 1970 26 p refs
(SC-RR-70-98) Avail: NTIS

Expressions for calculating radiation shield performance characteristics such as photon energy deposition inside the slab and the transmitted energy current are formulated in such a way that solutions to the adjoint transport can be used to advantage. A derivation is presented which shows how the adjoint solutions are related to the desired results. Finally, a sample problem is solved, and the results of real and adjoint transport calculations are compared. Author (NSA)

N70-39655# Naval Research Lab., Washington, D.C. Nuclear Physics Div.
IODINE FILTER TESTS AT THE NRL NUCLEAR REACTOR Interim Report
R. H. Vogt, E. H. Bebbe, K. W. Marlow, G. E. Holloway, and D. M. Shores 13 Apr. 1970 10 p refs
(AD-708378; NRL-7062) Avail: NTIS CSCL 18/10

Efficiency tests were performed on the iodine filters in the emergency air cleanup system of the NRL nuclear reactor. Author (TAB)

N70-39668# Instituto de Asuntos Nucleares, Bogota (Columbia).
CALCULATIONS AND NOMOGRAMS FOR PRODUCTION OF RADIOISOTOPES IN REACTORS [CALCULOS Y NOMOGRAMS PARA LA PRODUCCION DE RADIOISOTOPOS EN REACTORES]
J. G. Toro and H. A. Munera 1969 60 p refs In SPANISH
(IAN-ARI-2) Avail: AEC Depository Libraries

A series of cases of production of isotopes in reactors are presented in manual form. The deduction of the corresponding formulas, their simplification, and some practical examples of their use are given. The cases studied include: production of radioisotopes by (n,gamma) reactions, taking into account and not taking into account the attrition of the target nuclide; production by (n,gamma) reaction with subsequent beta decay without considering the attrition of the target nuclide; analysis of the previous case by considering the cooling time, production of (n,gamma) reaction and subsequent beta decay considering the burn-up of the target nuclide; production of genetically related nuclear isomers by means of (n,gamma) reactions; and simple (n,gamma) reaction considering intermittent irradiation. NSA

N70-39681# Battelle-Northwest, Richland, FFTF Engineering Dept.
OPEN- AND CLOSED-LOOP TOP CLOSURE REMOTE CUTTING AND WELDING EVALUATION
R. F. Gilmore May 1970 122 p refs
(Contract AT(45-1)-1830)
(BNWL-1303) Avail: NTIS

One of the prime objectives of the FFTF is to perform nuclear fuels testing. The facility must have the capability to install and remove test assemblies by remotely controlled equipment. The development and testing of equipment with which to weld and cut the open- and closed-loop reactor top closures for removal and reinstallation of experimental test assemblies is discussed. Author (NSA)

N70-39685# Oak Ridge National Chemical Technology Div.
AQUEOUS PROCESSING OF LMFBR FUELS: TECHNICAL ASSESSMENT AND EXPERIMENTAL PROGRAM DEFINITION
Jun. 1970 414 p refs
(Contract W-7405-eng-26)
(ORNL-4436) Avail: NTIS

The development program initiated for the resolution of problems posed by the processing of spent fuels from liquid metal fast breeder reactors is described. These fuels cannot be transported and processed by methods currently employed for light water reactor fuels owing to the high decay heat evolution and to the high plutonium content, which alters chemical requirements and necessititates considerations of criticality. Author (NSA)

N70-39686# Oak Ridge National Lab., Tenn. Chemical Technology Div.
THORIUM FUEL CYCLE DEVELOPMENT Progress Report
R. E. Blanco, W. E. Unger, V. C. A. Vaughen, C. D. Watson, R. G. Wymer et al Jun. 1970 22 p ref
(Contract W-7405-eng-26)
(ORNL-TM-3032; PR-10) Avail: NTIS

Topics covered include: head-end reprocessing development, refabrication development, materials irradiation and U-233 reprocessing. NSA

N70-39712 Michigan Univ., Ann Arbor.
APPLICATIONS OF LANGEVIN'S METHOD TO SOME REACTOR RELEATED FLUCTUATION PROBLEMS
Juan Maria Nieto (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-18070

Langevin's technique is applied to three types of problems. First, the filtering effects of detectors used in fluctuation measurements are investigated. General results are obtained which are applicable to a large class of detection systems. Second, a two-energy group reactor model with delayed neutrons is investigated. Power spectral densities for the detection rates in both groups are obtained as well as the cross-power spectral density of the fast with the thermal reaction rates. Third, the space-dependent theory of the fluctuations of prompt fast gammas from fission is investigated. The connection between the spectral density of the gamma fluctuations and that of the neutron fluctuations is obtained. Dissert. Abstr.

N70-39722# United Kingdom Atomic Energy Authority, Risley (England).
HOTSPOT: AN IBM 7090 COMPUTER PROGRAMME FOR CALCULATION OF SYSTEMATIC CAN AND FUEL TEMPERATURES IN GAS-COOLED ROD-CLUSTER FUEL CHANNELS
C. B. Cowking Feb. 1970 44 p refs
(TRG-Rept-1961(R)) Avail: AEC Depository Libraries; HMSO 5s. 6d; BIS $1.10

The HOTSPOT computer program performs detailed channel heat transfer calculations for gas-cooled rod-cluster fuel elements formed on cocentric rings of fuel rods allowing for many of the factors which give rise to systematic can and fuel temperature variations. Nonuniform radial distribution of coolant flow and the variations in rating radially between and within rings of fuel rods and axially within assemblies and along the channel, are considered. The amelio-rating influences of heat and mass flow between the parallel coolant passages are also included in the calculation. Circumferential symmetry is assumed. The method is aligned with the results of twice-full-scale out-of-pile experiments in air and carbon dioxide. The equations forming the bases of the program, the computer input details, and all the data involved in a specimen calculation are given. Author (NSA)

N70-39732# Oak Ridge National Lab., Tenn. Chemical Technology Div.
THORIUM FUEL CYCLE DEVELOPMENT Progress Report, Mar. 1970
R. E. Blanco, W. E. Unger, V. C. A. Vaughen, C. D. Watson, R. G. Wymer et al Jun. 1970 24 p ref
(Contract W-7405-eng-26)
(ORNL-TM-3004; PR-8) Avail: NTIS

Topics covered include: head-end reprocessing development, refabrication development, materials irradiation, and uranium-233 reprocessing. NSA

N70-39733# Battelle-Northwest, Richland, Wash. Reactor and Plant Technology Dept.
INTERMEDIATE HEAT EXCHANGER MODELING FOR FFTF SIMULATION
A. L. Gunby May 1970 60 p refs
(Contract AT(45-1)-1830)
(BNWL-1367) Avail: NTIS

Several IHX modeling techniques were examined, using an example IHX design and example flow and temperature transients. For the purposes of FFTF system simulation (system thermal transients, control design, operator training), a mixed difference model (alternating central difference and three point-backward difference at each axial mesh point) was selected as the best single model. Model simplifications were investigated, resulting in a model with: tube metal lumped with sodium, constant metal and sodium properties, four axial nodes, and a single average heat transfer coefficient based on average coolant temperatures. Author (NSA)

N70-39738# Kyoto Univ. (Japan). Research Reactor Inst.
ON THE THERMAL NEUTRON EXPOSURE TUBE OF KUR
[1969] 12 p refs In JAPANESE; ENGLISH summary
(KURRI-TR-64) Avail: AEC Depository Library

The thermal neutron exposure tube, E-2 tube, of KUR is frequently utilized by biologists, chemists, and other researchers for irradiation by thermal neutrons. Recently, an exposure device was mounted on this tube in order that the insertion and the withdrawal of a sample for irradiation during the reactor operation could be possible with negligible radiation dose to handlers. The details of its structure and the results of the measurement of neutron flux and gamma-ray dose rate in this device are described. Author (NSA)

N70-39748# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
THE INFLUENCE OF COMPACTING PRESSURE AND OTHER FACTORS ON THE SINTERING OF UO2
D. Kolar, B. Zatler, B. S. Brcic, and V. Marinkovic Nov. 1969 11 p refs Presented at the Yugoslavia Conf. on Ind. Chem. Belgrade, 10-14 Jun. 1969
(IJS-251; Conf-690636-2) Avail: AEC Depository Libraries

The final density and microstructure of sintered UO2 pellets depend on the powder characteristics and pressing and sintering conditions. The investigation demonstrated the negative influence of the parameters, which, used separately, in some intervals promote the densification, i.e., increased specific surface area, and nonstoichiometry. Sintering results are supported by the microstructure investigations. Author (NSA)

N70-39763*# General Electric Co., Cincinnati, Ohio.
POTASSIUM TURBOLATERNATOR PRELIMINARY DESIGN STUDY. 1: COMPONENT PARAMETRIC DATA AND INITIAL INTEGRATED TURBOALTERNATOR ANALYSES, PHASE 1
E. Schnetzer, ed. Washington NASA Sep. 1970 745 p refs
(Contract NAS3-10933)
(NASA-CR-1586; GESP-296) Avail: NTIS HC$10.00/MF$0.65

Parametric design of components and configurations were compiled in preparation of conceptual design studies of potassium turboalternators for space. The 2100 F turbine inlet, 3 to 5 years life, and 800 to 1100 F potassium lubricant and coolant are some of the basic design requirements. Elimination or control of turbine erosion and consideration of oil as an alternate lubricant and coolant were additional design conditions. Radial gap inductor alternators were subjected to comprehensive screening analyses to select conceptual 733 kVA designs. As the result of the screening studies, three conceptual designs at 1600 Hz, 480 V and 19,200 and 24,000 rpm were selected for detailed analysis and design. Auxiliary studies, not directly associated with the design selection analyses, were carried out to evaluate motoring capability, magnetic unbalance and reliability considerations. A number of 2 shaft, 4 bearing configurations using cradled and overhung turbines were evolved. Performance and weight data as well as comparative risk and life expectancy have been established. Bearing/rotor response analysis contributed an important criterion to design selection. Author

N70-39784# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES: SUBCHANNEL AND PRESSURE DROP MEASUREMENTS IN A NINE-ROD BUNDLE FOR DIABATIC AND ADIABATIC CONDITIONS

R. T. Lahey, Jr., B. S.Shiralkar, and D. W. Radcliffe Mar. 1970 130 p refs
(Contract AT(04-3)-189)
(GEAP-13049) Avail: NTIS

Extensive subchannel test data have been taken in an electrically heated nine-rod bundle under conditions typical of BWR operating conditions. Uniform and peaked local (radial) power distributions were run in order to determine the effect of the rod-peaking pattern on subchannel conditions. Analysis of the isokinetic and nonisokinetic subchannel data indicates that: (1) variation of flow and enthalpy within a rod bundle is quite pronounced; (2) current ventilated-subchannel codes, such as COBRA, do not accurately predict the trends in the data for two-phase conditions; (3) the crossflow enthalpy transferred during flow diversion is, in general, greater than the enthalpy of the donor subchannel and appears to be a strong function of flow regime; (4) the present data agree in general with previous adiabatic and diabatic subchannel data. In addition to subchannel data, pressure-drop measurements were made for single-phase and two-phase conditions. Author (NSA)

N70-39785# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.
THE SATURN CODE: A THEORETICAL ANALYSIS OF FUEL PIN BEHAVIOR AND FUEL VOID DYNAMICS
H. Kaempf and G. Karsten Nov. 1969 42 p refs
(KFK-1088; EURFNR-755) Avail: AEC Depository Libraries

The SATURN-Code, swell and thermal analysis under reactor conditions, contains a macroscopic modelling analysis of the thermal and mechanical effects of the different types of void volumes. The thermal effects of the porosity, central void, and open gas gap are analyzed. A relation for the porosity dependence of the thermal conductivity is deducted. For given gas contents and determined ranges of pore temperatures and sizes, a simple approximate equation results. Central void is very effective in reducing the central temperature; making use of it means increasing the linear rod power. The in-pile migration of the prosotiy in the hotter regions of oxide fuel forms increases the central void and densifies the hotter region. This effect is calculated by a two-zone porosity model. For the open ideal gap fuel-clad filled with inert gases and mixtures of He with fission product gas mixtures, the temperature drop is calculated as a function of gap width, linear rod power, clad inside temperature and clad inside radius. The interaction behavior and burnup behavior are also analyzed. Author (NSA)

N70-39805# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
KINETICS OF FISSION-FRAGMENT YIELD FROM SINGLE-CRYSTAL UO2
B. V. Samsonov et al 1969 13 p refs Transl. into ENGLISH from Russian preprint NIIAR-P-26
(AERE-Trans-1119) Avail: AEC Depository Libraries; HMSO 2s 6d; BIS $0.50

The method of determination of fission fragment yield from the fuel is developed, and some experimental results on the diffision coefficients of Xe-133, Xe-135, Xe-138 and I-133, I-135 isotopes during thermal neutron irradiation are given. Author (NSA)

N70-39807# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.
SINGLE-PURPOSE DIGITAL COMPUTER IN NUCLEAR ENGINEERING
F. Drab, B. Lnenicka, and L. Kocandrle 1970 9 p refs
(ZJE-72) Avail: AEC Depository Libraries

The possibilities of using a digital computer in nuclear engineering are discussed, with special reference to the control of nuclear reactors. Author (NSA)

N70-39817# Central Research Inst. for Physics, Budapest (Hungary).
THEORETICAL AND EXPERIMENTAL STUDIES OF TWO-REGION REACTOR
A. I. Mogilner, E. F. Semanov, D. M. Shvetsov, and Z. Satmari 1969 20 p refs In RUSSIAN
(KFKI-23/1969) Avail: AEC Depository Libraries

The behavior of a reactor with strongly differing regions, such as the core and the reflector, was studied by means of a theoretical model. The results obtained for determining the reactivity by using a pulsed neutron generator were found to be applicable for the case involving the injection of neutrons into the reflector. The position of the detector did not affect the value of the reactivity. The kinetics of 2-region reactors may be better understood by studying the difference between stationary and nonstationary flux, decomposing the neutron density drop into two exponential functions. NSA

N70-39818# Kernforschungszentrum, Karlsruhe (West Germany).
SODIUM CORROSION EXPERIMENT WITH STEEL FUEL ELEMENT CANS FOR A SODIUM-COOLED FAST BREEDER REACTOR [NATRIUMKORROSIONSVERSUCHE AN BRENNELEMENTHUELLSTAEHLEN FUER EINEN NATRIUMGEKUEHLTEN SCHNELLEN BRUTREAKTOR]
Hans U. Borgstedt, Guenter Frees, and Guenther Drechsler Aug. 1969 19 p refs In GERMAN
(KFK-991; EUR-4300) Avail: AEC Depository Libraries

Results of corrosion studies on the German high-temperature stable austenitic steels No. 4961, 4981, and 4988 in the sodium loop Cerberus were used to establish annual wall thickness losses at 0.0 × 0.0001 cm/yr and 500 C; 0.10 × 0.0001 at 500 C; and 0.15 × at 0.0001 at 600 C. These values are qualitatively in agreement with literature values. They show that the German steels tested in sodium behave similarly to the U.S. steels AISI 304 and 316. After about 5000 hr in sodium, the effects on contents in interstitial components are not measurable in these steels. Author (NSA)

N70-39824# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
BRAUNSCHWEIG RESEARCH AND MEASUREMENT REACTOR Operations Report, Nov. 1968-Dec. 1969 [UEBER DEN BETRIEB DES FORSCHUNGS- UND MESSREAKTORS BRAUNSCHWEIG Erfahrungsbericht, Nov. 1968-Dez. 1969]
W. Heintz and V. Siegel Dec. 1969 60 p refs In GERMAN; ENGLISH summary
(FMRB-30/69) Avail: AEC Depository Libraries

The operating experience and radiation protection activities with the Forschungs und Messreaktor in the year 1969 are described. After raising the primary coolant flow and installation of the heavy water tank, the reactor could be operated with two coupled cores at 1 MW. Author (NSA)

N70-39888# Organization for Economic Co-operation and Development, Paris (France).
OECD HIGH TEMPERATURE REACTOR PROJECT (DRAGON) Annual Report, 1968-1969
1969 175 p refs
(NP-18148; AR-10) Avail: AEC Depository Libraries

Research accomplishments over a 10 year period of operation are reviewed. The material is presented under the following headings: (1) reactor operation; (2) third charge irradiation; (3) diffusion tube probe in Dragon primary circuit; (4) primary heat exchanger corrosion problems; (5) plant performance and maintenance; (6) operational reactor physics; (7) reactor safety; (8) fuel research and development; (9) fuel irradiation and evaluation; (10) fuel production and development; (11) physics and fuel cycles; (12) H.T.R. technology; (13) engineering; and (14) experimental and development work. D.L.G.

N70-39871# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.
THE DEVELOPMENT OF CALORIMETRY IN THE SKODA NUCLEAR POWER PLANTS DIVISION
J. Kott 1970 7 p
(ZJE-70) Avail: AEC Depository Libraries

The development of calorimeters, their different types according to their usability, and the measurements made on different reactors both in Czechoslovakia and abroad are described. Author (NSA)

N70-39909# Organization for Economic Co-operation and Development, Paris (France).
OECD HALDEN REACTOR PROJECT Annual Report, 1968
1968 179 p refs
(NP-18149) Avail: AEC Depository Libraries

The operational summary for the boiling water reactor contains corrosion testing activities and iodine distribution measurements in the cooling system. Also described is the development of a digital computer control system and of instruments for radiation measurements in the core. NSA

N70-40010# Oregon State Univ., Corvallis.
MODAL METHODS FOR COMPUTING FAST REACTOR SPECTRA
Paul G. Lorenzini (Ph.D. Thesis) 1 Nov. 1969 161 p refs
(Contract AT(45-1)-2058)
(RLO-2058-2) Avail: NTIS

A modal method of representing neutron spectra in fast reactors is presented for two dimensional diffusion theory calculations. The method is applied to a 1000 MW(e) fast reactor design and the EBR-2 core. NSA

N70-40011# Los Alamos Scientific Lab., N.Mex.
ANALYSIS OF UHTREX TRANSIENT EXPERIMENTS
John C. Vigil Nov. 1969 15 p refs
(Contract W-7405-eng-36)
(LA-4412) Avail: NTIS

Numerical calculations of transients in UHTREX agree well with experimental measurements. The good agreement confirms the existence and magnitude of the negative fuel element temperature coefficient and provides support for the methods used in the analysis. Author (NSA)

N70-40035# Gulf General Atomic, San Diego, Calif.
FAST REACTOR SPECTRUM MEASUREMENTS Technical Summary Report, 1 Feb. 1969 – 31 Jan. 1970
J. C. Young, D. d'Oultremont, and J. M. Neill 27 Feb. 1970 107 p refs
(Contract AT(04-3)-167)
(GA-9946) Avail: NTIS

The use of the Subcritical Time-of-Flight Spectral Facility (STSF) for the measurement of neutron spectra, neutron dieaway, and fission ratios in fast subcritical assemblies driven by a 45-MeV LINAC is reported. Four cores were studied extensively. Two of the cores (STF-2 and STSF-2A) were simple, single-zone assemblies similar to ZPR-3 Assembly 17. Time-of-flight spectral investigations and ground work for two-parameter studies (time-of-flight vs pulse height) were performed in STSF-2, while a test of the kinetics codes used in data reduction was investigated in STSF-2A. Comparisons of the spectral data taken in STSF-2 with calculations performed using the 1DF code were satisfactory over most of the energy range studied. Extensive studies of the spectra in the central zones of STSF-5 and -6 were also performed. These two cores are similar to ZPR-9 assembly 11 with STSF-6 having a Na void in the central region. Author (NSA)

N70-40045# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
REPROCESSING OF ENRICHED URANIUM ALLOYS BY THE FLUORIDE VOLATILITY PROCESS IN THE HOT FACILITY ATTILA [RESULTATS OBTENUS DANS L'INSTALLATION "ATTILA" SUR LE RETRAITEMENT DES ALLIAGES D'URANIUM ENRICHI PAR VOTALISATION DES FLUORURES]
M. Bourgeois, M. Perrot, and Y. Rochedereux 1969 16 p refs In FRENCH Presented at the 2d Spanish-French Symp. on Fuel Reprocessing and Plutonium Chem., Madrid, 17-19 Nov. 1969
(CEA-CONF-1537; CONF-691122-2) Avail: AEC Depository Libraries

Five tests were carried out on irradiated fuel elements in the hot facility Attila. The operating conditions are described. They include fuel loading, chlorination and pyrohydrolysis of volatile chlorides, UF6 fluorination and absorption on NaF, recovery of UF6 and sampling and analysis of solid products. Chlorination rates of 1 and 0.4 kg/h can be obtained at 450 C for the alloys U – Zr and U – Al. The major portion of the Kr-85 formed in the chlorination-pyrohydrolysis of chlorides was eliminated and the presence of I-131 and Sb-125 was observed. No disposal of radioactive compounds could be observed in gaseous effluents through the fluorination-absorption of UF6 on NaF. Nearly all the fission products (Ru, Cs, Ce) remain in the reactor alumina for the tests made on cooled fuel. Only Ru is distributed over the reactor and the static bed filter if testing is effected on slightly cooled fuel. NSA

N70-40047# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Mar. 1970
27 Apr. 1970 178 p
(Contract W-31-09-eng-38)
(ANL-7679) Avail: NTIS

LMFBR physics development, component development, and Na technology are reviewed. Operations and analysis of ZPR-3, ZPR-6, ZPR-9, and ZPPR are described. The EBR-2 research and development projects, fuel fabrication, and operations are summarized. Reactor fuels and materials development, physics studies, engineering development, fuel cycle chemistry, and LMFBR safety studies are reported. NSA

N70-40195# Gulf General Atomic, San Diego, Calif.
BRITL: A FUEL ROD ANALYTICAL MODEL FOR THERMAL OR FAST FLUX IRRADIATIONS
W. I. Thompson 1 Apr. 1970 32 p refs
(Contract AT(04-3)-167)
(GAMD-10007) Avail: NTIS

The BRITL computer program was developed to study interactions between fuel and cladding in cylindrical oxide fuel elements under the action of either a thermal or fast neutron flux. The program allows for initial cracking to relieve thermal tensile stresses resulting from the high internal temperature gradients. NSA

N70-40200# United Kingdom Atomic Energy Authority, Harwell (England). Applied Chemistry Div.
A GALVANIC CELL TECHNIQUE FOR THE RAPID MEASUREMENT OF VARIATIONS OF O/U RATIOS IN OXIDE FUEL PELLETS
R. J. Bones, R. F. A. Carney Dec. 1969 13 p refs
(AERE-R-6301) Avail: AEC Depository Libraries; HMSO 3s; BIS $0.60

A miniaturized high temperature galvanic cell in the form of a fine probe has been developed. This allows the determination of O/U ratios at localized points in a uranium oxide pellet. The technique has been employed, using multiple probes, to determine the radial distribution of oxygen across a reactor fuel pellet. Measurements are made at 700 to 750 C where equilibrium is attained within minutes. The apparatus permits a rapid, nondestructive determination of oxygen redistribution in a temperature gradient. With development it should be applicable to uranium/plutonium oxides and, used remotely, for irradiated fuels. Author (NSA)

N70-40215# Battelle-Northwest, Richland, Wash.. Pacific Northwest Lab.
THE NONDESTRUCTIVE EXAMINATION OF G AND H LOTS FFTF FUEL CLADDING
J. Ryden, Jr. and E. F. Perrizo May 1970 21 p refs
(Contract AT(45-1)-1830)
(BNWL-1359) Avail: NTIS

An inspection for defects, using ultrasonic techniques, has been performed on 2744 ft of small diameter stainless steel tubing (G and H Lots). The intended use for this tubing was as reactor fuel cladding in fuel performance studies for the Fast Flux Test Facility (FFTF). The ultrasonic pulse-echo inspection mode was used to detect and reject defects equal to or greater than 8% of the wall thickness in depth. Statistical control techniques were used to maintain the precision of the tester to a known value. Although the two lots had the same metallurgical composition, they were fabricated differently. The H Lot tubes were fabricated in a conventional manner. The G Lot received extra treatment and care in the fabrication in an attempt to reduce the number of rejectable defects. The test results verified that G Lot did have fewer defects; i.e., 8% for G Lot versus 15% for H Lot. Author (NSA)

N70-40225# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DBUFIT-1: A LEAST SQUARES ANALYSIS CODE FOR NUCLEAR BURNUP DATA
R. P. Matsen May 1970 63 p refs
(Contract AT(45-1)-1830)
(BNWL-1396) Avail: NTIS

The computer code, DBUFIT-I, is designed to extract integral cross section information from isotopic burnup data. This information is obtained by fitting burnup equations to the isotopic data using least squares fitting techniques. The burnup equations applicable to Pu and U–Pu fuels are described. The application of the code is illustrated by a sample burnup problem. Author (NSA)

N70-40248# Battelle-Northwest Richland, Wash. Pacific Northwest Lab.
FAST FLUX TEST FACILITY Summary Technical Report, Jan.–Dec. 1968
C. P. Cabell, comp. Jun. 1970 91 p refs
(Contract AT(45-1)-1830)
(BNWL-325) Avail: NTIS

The research activities of the FFTF for CY 1969 are reported. Topics include: plant design, heat transport system, control system, sodium technology, core design, physics, and safety. F.O.S.

N70-40262# Hittman Associates, Inc., Columbia, Md.
PM-3A TYPE 4 CORE ANALYSIS: COMPARISON OF MEASURED AND CALCULATED DATA AND DATA FOR THE TEST MANUAL
Apr. 1970 32 p refs
(Contract AT(30-1)-3775)
(HIT-3775-3; HIT-445) Avail: NTIS

A comparison of the Zero Power Experiment (ZPE) measured data and the final design calculations for the PM Type 4 cores are presented. The Test Data Manual curves, revised to reflect the ZPE results and a limited set of calculations performed after the ZPE data were obtained, are also presented. ZPE measurements were performed on two cores of the Type 4 design by two different facilities. The Core 2 experiments were more complete and were the primary source of ZPE data reported. The measurements on both cores were performed with several different numbers of removable burnable poison elements replacing the removable fuel elements in the cores. The final design calculations were all performed with 24 removable fuel elements and no removable burnable poison elements inserted in the core. In the preparation of the Test Data Manual curves, the calculated data have been modified, where necessary, to account for the presence of removable burnable poison elements in place of the removable fuel elements. Author (NSA)

N70-40263# Idaho Nuclear Corp., Idaho Falls.
LOSS-OF-COOLANT ACCIDENT ANALYSIS PROGRAM
Jun. 1970 49 p refs
(Contract AT(10-1)-1230)
(IN-1382) Avail: NTIS

The Loss-of-Coolant Accident Analysis Program provides experimentally-verified analytical techniques for the Loss-of-Fluid Test (LOFT) Program and for the evaluation of light-water power reactors during a loss-of-coolant accident. The principal features of the Loss-of-Coolant Analysis Program include core thermal models, primary loop hydraulic models, structural models, and containment models. Included is a description of the purpose, objectives, and justification of the Loss-of-Coolant Accident Analysis Program as well as the relationship to other nuclear safety programs. The models developed, the work which has been accomplished on each of these models to the present time, and the computer codes which employ these models are also described. The computer codes include MOXY, THETA1, RELAP3, STRAP, and CONTEMPT-PS. A time schedule and work plan are also included for future development of these models. Author (NSA)

N70-40264# Idaho Nuclear Corp., Idaho Falls.
TECHNICAL ASSISTANCE IN REACTOR SAFETY ANALYSIS
J. C. Haire and G. F. Brockett May 1970 34 p refs
(Contract AT(10-1)-1230)
(IN-1383) Avail: NTIS

The scope of the reactor safety program includes: (a) application of analytical models for determining reactor system behavior and evaluating engineered safety system performance under loss-of-coolant accident (LOCA) conditions for commercial nuclear power plants of current or advanced design and (b) assessment of these analytical models by comparing calculated results with experimental data. Work is currently directed toward five major interrelated facets of the loss-of-coolant accident: (1) analysis of subcooled blowdown phenomena, (2) analysis of ECC performance, (3) analysis of saturated blowdown phenomena, (4) analysis of containment response, and (5) analysis of structural response. Author (NSA)

N70-40285 Argonne National Lab., Ill.
LOADING DIAGRAMS OF EXPERIMENTAL SUBASSEMBLIES IRRADIATED IN EBR-2 RUNS 5 THROUGH 42
J. C. Case, comp. May 1970 99 p
(Contract W-31-109-eng-38)
(ANL/EBR-15) Avail: NTIS

The loading diagrams are presented for all experimental subassemblies as they were fabricated for irradiation in EBR-2 runs 5 through 42. Each diagram gives the location, identification number, and content of each element in the subassembly. Information with each diagram gives the type of hardware, orifice size, results of flow testing of the fabricated assembly, date and place of assembly, and date placed into the reactor. NSA

N70-40286# Douglas United Nuclear, Inc., Richland, Wash.
THE XENON INSTABILITY PHENOMENON: TIME FOR RETIREMENT
G. C. Fullmer 28 May 1970 5 p refs Presented at the Am. Nucl. Society Meeting, Los Angeles, 28 Jun.–2 Jul. 1970
(Contract AT(45-1)-1857)
(DUN-SA-133; CONF-700608-3) Avail: NTIS

The three main points discussed are: (1) xenon oscillation is not nuclear safety problem; (2) properly designed kinetics protection for control withdrawal accidents will easily protect against the much less severe xenon phenomenon; and (3) even the maximum peaking potential from xenon oscillation may be easily

and conservatively estimated from first principles. A brief review is also made of the local trend concept for precluding xenon oscillations by operating procedure. Author (NSA)

N70-40287# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SAFETY ANALYSIS PROGRAM
13 Feb. 1969 58 p refs
(Contract AT(45-1)-1830)
(BNWL-1059) Avail: NTIS

The objectives and activities of the safety analysis program for the FFTF are defined. Assigned responsibilities related to the safety analysis program are described. NSA

N70-40288# Argonne National Lab., Ill.
SYMPTOMS AND DETECTION OF A FISSION-PRODUCT RELEASE FROM AN EBR-2 FUEL ELEMENT. CASE 1: DEFECT ABOVE FUEL ELEVATION
R. M. Fryer, E. R. Ebersole, P. B. Henault, and R. R. Smith Jan. 1970 36 p refs
(Contract W-31-109-ENG-38)
(ANL-7605) Avail: NTIS

Shortly after a routine reactor startup in September 1968, the equilibrium activity of Xe-135 in the primary cover gas increased to a level twice that noted during previous power runs. The increase was gradual, continuous, and consistent with the half-lives of the respective iodine-xenon fission-product pair. Analyses of primary coolant samples revealed a corresponding increase in the activity level of I-131. No increase was registered by either the FERD or the FGM. Since the FERD and FGM are sensitive to delayed-neutron emitters and to their daughters, respectively, discrimination against shorter lived halogen fission products was evident. From this evidence and from the shape of the Xe-135 buildup curve, it was concluded that bond sodium containing relatively long-lived halogen fission products was being extruded through a cladding perforation. The results of exposed-fuel calibration studies subsequently confirmed the release, and mathematical models of the release rate were developed. Author (NSA)

N70-40289# Oak Ridge National Lab., Tenn.
REMOVAL OF RADIOACTIVE AEROSOLS ON HIGH EFFICIENCY FIBROUS FILTER MEDIA
R. J. Davis, J. Truitt, J. S. Gill, and R. E. Adams Jun. 1970 55 p refs
(Contract W-7405-eng-26)
(ORNL-4524) Avail: NTIS

One objective was to observe filtration efficiencies of commercially available, high efficiency fibrous filter media to smokes of those materials possible and under environmental conditions expected in water-cooled reactor containments during a severe accident. A second objective was to provide additional understanding of the performance of high efficiency fibrous filters. The basic experiments were filtration efficiency tests in which aerosol was generated in an electric arc between an activated stainless steel (or zirconium) tube filled with an insert of UO2 and tungsten. The aerosol was pumped through a filter pack which contained three filters in series. The filtration efficiency was taken to be the ratio of the activity on the first filter to the total on all three filters. Filter efficiency was measured for eight different commercial media vs velocity (3.5-10 ft/min), humidity (zero to 100% relative humidity) and temperature (25, 60 and 100 C). Author (NSA)

N70-40305# Argonne National Lab., Ill.
HYBRID SIMULATIONS OF ENERGY AND SPACE DEPENDENT CORE DYNAMICS
J. C. Carter, N. F. Morehouse, L. W. Amiot, and F. J. Maletich Feb. 1970 37 p
(Contract W-31-109-eng-38)
(ANL-7626) Avail: NTIS

A small and relatively slow hybrid computer has been assembled for the purpose of gaining experience and evaluating the potential of simulating large mathematical models of reactor systems. The first simulation presented is a model consisting of the two-group, space- and time-dependent neutron-diffusion equations with delayed groups, two-dimensional heat transfer in each of three core regions, and reactivity feedbacks from each region due to Doppler effect and changes in the physical properties of fuel and coolant. The cylindrical volume of a 1000 MW(e) fast reactor is divided into five radial increments and six axial increments. Coupling between radial and axial increments is by heat flow and neutron diffusion. The solution over the volume of the core is achieved by multiplexing equations and by using iterative techniques. Author (NSA)

N70-40374# Atomics International, Canoga Park, Calif.
LMFBR PHYSICS PROGRAMS Quarterly Technical Progress Report, Jan.–Mar. 1970
15 May 1970 35 p
(Contract AT(04-3)-701)
(AI-AEC-12948) Avail: NTIS

Experiments on determining the reactivity worth of tantalum in clusters with and without sodium around the control rods are reported. Calculations of the Doppler effect of uranium 238 in core 17, and the research activities in reactor physics are included. The results are summarized in tables. F.O.S.

N70-40378# Argonne National Lab., Ill.
BURNUP: A CODE TO CALCULATE BURNUP OF EBR-2 FUEL
S. M. Masters, I. A. Engen, and F. S. Kirn Feb. 1970 38 p refs
(Contract W-31-109-eng-38)
(ANL-EBR-9) Avail: NTIS

The EBR-2 BURNUP code was developed to provide a record of subassembly disposition and to calculate fuel burnup and irradiation time to a certain burnup limit for each subassembly in the reactor during a given run. A historical record is kept of each partially irradiated subassembly that has not yet been transferred from the reactor storage basket. The nuclear center of the reactor is found from the calibrated worths of the control rods for each run. The purposes, functions, and input and output for the code are presented. Author (NSA)

N70-40398# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki.
CONCERNING THE CHOICE OF THE SCHEME AND THE MAIN PARAMETERS OF THE ITEP BOOSTER
V. K. Plotnikov 1969 46 p refs In RUSSIAN
(ITEF-738) Avail: AEC Depository Libraries

The choice of the scheme and the main parameters of the booster are considered. It is shown that to increase the intensity of the ITEP proton synchrotron up to (5 to 10)·10 to the 12th power particles per pulse, both fast and slow boosters may be used. The main parameters of two variations of fast boosters (with the length of the equilibrium orbit 26 and 31 m) and of one slow booster (with the length of the orbit 62.5 m) are found. The parameters of the accelerating and magnet systems and some characteristics of particle motion for all three variations of boosters are estimated. Virtues and defects of fast and slow boosters are given. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N70-39022 + Nihon Univ., Tokyo (Japan). Dept. of Physics.
INFINITE COMPONENT WAVE EQUATION AND SCATTERING AMPLITUDE
Jun Otokozawa and Tetsuo Goto [1969] 27 p refs
(NUP-A-70-8) Avail: NTIS

The scattering amplitude of an infinite component field by a scalar external field is calculated in the lowest order diagram. It is explicitly shown that from the crossed diagram the Regge pole does not arise and, therefore, two amplitudes corresponding to ordinary and crossed diagrams cannot be continued analytically from one to another. Author

N70-39078 Boston Univ., Mass.
MAGNETICALLY INDUCED QUADRUPOLE INTERACTIONS IN SOME NORMAL SPINEL IRON COMPOUNDS
Kanchan Pal Singh (Ph.D. Thesis) 1969 214 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-18421

Magnetically induced quadrupole interactions in the normal thio-spinel FeCr2S4 are studied using Mossbauer spectroscopy. The Mossbauer effect using Fe-57 nuclei has made it possible to determine not only the magnitudes of the internal magnetic field H, the electric field gradient (EFG) q and the asymmetry parameter eta but also the sign of the EFG and the orientation of H with respect to the principal axes of the EFG tensor. The measurements of hyperfine spectra at various temperatures determine the temperature dependences of H and q, and also the magnetic ordering temperature. The sign of q gives information concerning the ground state of the Fe(2+) ion. The temperature dependence of H shows that this compound becomes magnetically ordered at about 172 K. The Mossbauer spectra at temperatures higher than 172 K show a single peak indicating that the environment of Fe(2+) ions is cubic. Dissert. Abstr.

N70-39103 University of Southern Calif., Los Angeles.
ANALYSIS OF SELF-FOCUSING OF OPTICAL BEAMS AND CALCULATION OF THIRD ORDER NONLINEAR SUSCEPTIBILITY COEFFICIENTS FOR THE INERT GASES
Eddie Lee Dawes (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-19365

Extensive numerical solutions of the electromagnetic wave equation, the self-focusing equation, with a saturable, complex, intensity dependent index of refraction are presented and analyzed. The large-scale self-focusing region is fully explored, relationships are found between the self-focusing length and the dynamical critical power, approximate analytical solutions for the on-axis intensity are given for a wide range of input powers, a procedure is set forth for obtaining the characteristic curves employed, and the effects of linear absorption are discussed. Some aspects of the small-scale self-trapping region are also investigated. Saturation of the nonlinear index of refraction leads to the dynamical formation of rings in the transverse intensity profile with the persistence of a very high intensity beyond the focus in a region very near the axis. An analysis of the region of validity of the self-focusing equation and a thorough discussion of the mesh technique used to obtain the numerical solutions are included. Dissert. Abstr.

N70-39280 Purdue Univ., Lafayette, Ind.
AN EXPERIMENTAL INVESTIGATION OF THE INTERACTION OF A DEVELOPING TURBULENT FLOW WITH A LONGITUDINALLY RESONANT ACOUSTIC FIELD IN A HORIZONTAL PIPE
Kent Charles Williams (Ph.D Thesis) 1969 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order no. 69-17292

An experimental study was conducted to determine the effect of a longitudinally resonant acoustic field on various fluctuating turbulent velocity components in a horizontal pipe. Data were taken for the longitudinal, radial, and circumferential velocity fluctuations with sound pressure levels up to 149.2 decibels. The one-dimensional turbulence spectrum of consecutive sound and no sound data runs were compared so that the relative effect of the sound on each turbulent component could be determined. Extensive use was made of the harmonic analysis of the turbulent fluctuations in order to detect effects in frequency bands not containing the periodic acoustic oscillation. A special technique was devised to record and analyze the spectrum of the longitudinal turbulence component when the test section was in acoustic resonance. The parameters of interest consisted of the axial location with respect to the acoustic resonance pattern, radial position, Reynolds number, and sound pressure level. Dissert. Abstr.

N70-39353 Stanford Univ., Calif.
PIEZOMAGNETISM: MACROSCOPIC AND MICROSCOPIC STUDIES
Richard Lee Townsend, Jr. (Ph.D. Thesis) 1969 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-17458

The group theory was used to develop criteria which lead to the prediction of new piezomagnetic materials, namely NiS, FeTiO3, CoTiO3, NiTiO3, CuFeS2, and the rare earth orthoferrites. A vibrating coil magnetometer was designed and built to measure the stress induced magnetic moment. This device was used to verify the prediction of piezomagnetism in NiS and to study the temperature dependence of two materials previously predicted to be piezomagnetic. A microscopic model was developed in an attempt to understand the physical mechanisms which cause piezomagnetism. The microscopic model permits the verification of the correct form of the piezomagnetic tensor and permits the calculation of the magnitude of the elements of the piezomagnetic tensor by relating the single ion magnetoelastic tensor to the macroscopically measured magnetic moment. Comparing the magnitudes of the piezomagnetic elements computed from the model with macroscopically measured magnitudes, good agreement was found. Dissert. Abstr.

N70-39390*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTICAL POLARIMETRIC PROPERTIES OF THE MATERIALS IN THE PAGEOS 1 AND ECHO 2 SATELLITE SURFACES
Robert Benjamin Lee, III Washington Sep. 1970 17 p refs
(NASA-TM-X-2089; L-6749) Avail: NTIS CSCL 20F

Laboratory measurements were made of the percent polarization of light reflected from materials representative of those in the PAGEOS 1 and Echo 2 satellite surfaces. The percent polarization was determined as a function of phase angle (angle between the incident and reflected light) from 10 deg to 168 deg in the ultraviolet, blue, and visual spectral bands. The PAGEOS 1 surface material was vapor-deposited aluminum on polyethylene terephthalate film, whereas the Echo 2 surface had an alodine coating chemically formed to a rolled aluminum-foil substrate. The polarization for the PAGEOS 1 surface was found to be in agreement with that calculated for vapor-deposited aluminum. The polarization for the Echo 2 surface was found to be greater than that for the rolled aluminum-foil substrate, both being dependent upon the orientation of the substrate line structure with respect to the plane of incidence. Author

N70-39476+ Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ACOUSTICAL CORRECTIONS IN THE IGREJA BATISTA ALEMA DE SAO PAULO [TRATAMENTO ACUSTICO DA IGREJA BATISTA ALEMA DE SAO PAULO]
L. X. Nepomuceno 13 May 1970 20 p In PORTUGUESE; ENGLISH summary
(TR-7005.429-B) AVAIL: NTIS

The ambient acoustical conditions, and the measured and calculated reverberation time are described for the acoustics

laboratory of Sao Paulo. The acoustical corrections necessary to bring the reveberation time to adequate levels for satisfactory intelligibility in the room are presented with the recommended acoustical materials and surface preparations. Author

N70-39526# Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
THE CALCULATION OF MAGNETIC FLUXES IN THREE PHASE CURRENT ASYNCHRONOUS MACHINES WITH CAGE ROTOR [DIE BERECHNUNG DER MAGNETISCHEN FLUESSE IN DREHSTROM- ASYNCHROMMASCHINEN MIT KAEFIGLAEUFER]
Helmut Schetelig (Ph.D. Thesis) 22 Jan. 1969 116 p refs In GERMAN
Avail: NTIS

Combination harmonic analysis and overall magnetic field properties are used to predict magnetic fluxes in cage rotor machines at arbitrary operating conditions. Considered are flux components in gear racks and yokes that pulsate at net frequencies, as well as higher harmonics of stages and rotor. Conditions in a three phase motor with unrestricted cage rotor are extended to a motor with slanted rotor whose rods are isolated against the rotor pack. Transl. by G.G.

N70-39987# Ohio State Univ., Columbus. ElectroScience Lab.
THE DYADIC DIFFRACTION COEFFICIENT FOR A PERFECTLY CONDUCTING WEDGE
P. H. Pathak and R. G. Kouyoumjian 5 Jun. 1970 96 p refs
(Contract AF 19(628)-5929)
(AD-707827; OSURF-2183-4; AFCRL-69-0546; SR-5) Avail: NTIS CSCL 20/14

A ray-fixed coordinate system is introduced and used to derive a new, compact form of the dyadic diffraction coefficient for an electromagnetic wave incident on a perfectly-conducting wedge. This diffraction coefficient is merely the sum of two dyads; furthermore, with the use of simple correction factors which have the same form for plane, cylindrical, conical or spherical waves incident on the edge, the dyadic diffraction coefficient is valid in the transition regions of the shadow and reflection boundaries. Author (TAB)

N70-40036# Syracuse Univ., N.Y. Dept. of Physics.
HAMILTONIAN FORMALISM ON CHARACTERISTIC SURFACES
Leroy Earl Eimers (Ph.D. Thesis) Jun. 1970 151 p
(Grant AF-AFOSR-1654-69)
(AD-708136; AFOSR-70-1805TR) Avail: NTIS CSCL 20/10

The problem of the construction of a Hamiltonian formalism suitable for propagation of a field off characteristic or null surfaces is considered. In the Hamiltonian theory of a massless scalar field, primary constraints arise. Certain integral combinations of these constraints generate the news function of the scalar field. Second-class combinations of constraints are eliminated by the construction of new variables differing from the original variables by the addition of constraints. Commutation relations are found for these variables. A Hamiltonian formalism for the electromagnetic field is developed on characteristic surfaces. A Hamiltonian for gravitation (general relativity) is constructed, first on null surfaces described only by the metric condition, g sup 00 = 0, and then on null surfaces coordinatized in a manner analegous to Bondis approach. Author (TAB)

N70-40065# RAND Corp., Santa Monica, Calif.
PROPAGATION OF A FINITE OPTICAL BEAM IN AN INHOMOGENEOUS MEDIUM
R. F. Lutomirski Apr. 1970 42 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-707861; RM-6055-ARPA) Avail: NTIS CSCL 20/6

The Memorandum is part of a study of the effect of atmospheric turbulence on optical and infrared reconnaissance and guidance equipment. A quantitative understanding of the manner in which an initially coherent beam of finite cross section propagates is required for the prediction of the performance of various devices employing lasers for target acquisition or guidance in tactical missions, optical communication systems, and other devices. The Memorandum calculates the mean intensity distribution for an arbitrary amplitude and phase distribution in a finite aperture in both the near and far field and examines in detail the case of a uniform distribution across a circular aperture. The results should be of use to those interested in propagation theory and its applications to laser range finders, laser line scanners, communication systems, and various guidance and other systems employing an illuminating beam. Author (TAB)

N70-40118# Harvard Univ., Cambridge, Mass. Dept. of Physics.
EXPERIMENTAL STUDY OF MOLECULAR PROCESSES IN LIQUIDS AT HIGH PRESSURES BY ACOUSTIC MEANS Final Project Report, 1966 – 1969
Gerald Holton 31 Dec. 1969 8 p *Its* High Pressure Lab. Commun. No. 27
(Contract Nonr-1866(57))
(AD-707434) Avail: NTIS CSCL 20/1

The report concerns the experimental study of molecular processes in liquids at high pressures by acoustic means and summarizes the over-all goals and activities of the work involved and presents a list of the personnel and published results of the project from the high pressure laboratory at Harvard University. Author (TAB)

N70-40138# Navy Underwater Sound Lab., New London, Conn.
PROCEEDINGS OF A SEMINAR ON APPLICATION OF FINITE AMPLITUDE, ACOUSTICS TO UNDERWATER SOUND
3 Mar. 1970 81 p refs Seminar Held at New London, Conn., 27 May 1968
(AD-707721; NUSL-1084; USAG-69-6) Avail: NTIS CSCL 20/1

A symposia on the application of finite-amplitude acoustics to underwater sound was held on 27 May 1968. The document presents the five papers given at that seminar: Nonlinear Acoustics; Nonlinear Interactions Between Acoustic Waves in Liquids - Possible Applications; Progress in Nonlinear Acoustics; Nonlinear Acoustic Research at NUSL; Two Experiments with Nonlinear Acoustics. TAB

N70-40168# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Semiannual Status Report, 1 Jun. – 30 Nov. 1969
Dec. 1969 57 p refs
(Contract N00014-67-A-0012-0039)
(AD-708762; ML-1825; SASR-1) Avail: NTIS CSCL 20/1

Eight projects were associated with this contract during the reporting period: Acoustic microscope; Electronic focusing in acoustic delay lines; Acoustic surface wave amplification; Theory of thin film waveguides; Electrostrictive acoustic amplifier; Two-step ultraviolet laser action; Tunable (1R) Raman laser; and Submillimeter wave generator. Results are discussed. TAB

N70-40188# Naval Postgraduate School, Monterey, Calif.
NONLINEAR EFFECTS IN A FOCUSED UNDERWATER ACOUSTIC SYSTEM
Kenneth Frank Scigulinsky (M.S. Thesis) Dec. 1969 56 p refs
(AD-707734) Avail: NTIS CSCL 20/1

A focused system having non-coincident foci was used to study the phenomenon of non-linear mixing in water. Primary frequencies of 343 kHz and 383 kHz provided a scattered difference frequency of 40 kHz. Enhancement of the difference frequency signal at incipient cavitation was verified. A delay between energization of the system and signal enhancement was linked to the state of non-linearity of the medium and provided strong evidence for the

existance of a virtual source at 40 kHz. Directivity measurements of the focused system at 40 kHz revealed a multilobed structure, but the presence of pseudosound degraded the measurements and attempts to correlate the lobe structure with a particular virtual source configuration were unsuccessful. Author (TAB)

N70-40223# Wyle Labs., Inc., Huntsville, Ala.
THE NOISINESS OF DIFFUSE SOUND FIELDS AT HIGH INTENSITIES Final Report
J. B. Ollerhead Aug. 1969 103 p refs
(Contract FA-68-WA-1971)
(AD-708816; WR-69-17; FAA-70-3) Avail: NTIS CSCL 20/1

An experimental study was conducted to establish the relationships between the subjective noisiness, frequency and sound pressure level of random noise in a diffuse acoustic field. The experiments were performed in a fabric enclosure installed within a 100,000 cubic foot reverberant chamber. Twenty-four subjects took part. The growth of noisiness with sound pressure level of an octave band of noise centered at 1000 Hz was determined. The variation of noisiness with frequency was measured at four perceived noise levels between 78 and 104 PNdB. For comparison purposes, one equal noisiness contour was also determined for free field listening conditions in a progressive wave chamber. The results indicated that currently used noisiness growth functions are adequate but that the equal noisiness contours may need some modification at low frequencies. Also the contour shapes vary as sound pressure level increases indicating relatively greater noise sensitivity at both high and low frequencies. Author (TAB)

N70-40231*# GCA Corp., Bedford, Mass. Technology Div.
TECHNIQUES APPLICABLE TO MASS SPECTROMETRY OF GASEOUS TRACE CONTAMINANTS Final Report
Peter Warneck Jun. 1970 41 p refs
(Contract NAS12-641)
(NASA-CR-109801; GCA-TR-70-5-N) Avail: NTIS CSCL 07D

A description is given of the continuation of an investigation into the application of charge transfer as the ionizing process in the ion source of the mass spectrometer. The experimental setup was modified in order to eliminate the interaction of sample gas with the primary ion source. Charge transfer mass spectra are given for the sample gases CO2, N2O, NH3, NO2, SO2, CO, isobutyl alcohol, and formic acid for singly charged krypton as the main primary ion. For the latter two a comparison of ion intensities is made with photoionization and electron impact mass spectra. The feasibility of utilizing negative preliminary ions for charge transfer was demonstrated for the process O(−), O2(−) + NO2 yields NO2(−) + O, O2. The feasibility of discriminating carbon monoxide in the presence of nitrogen by means of the mass number 28 signal was explored for krypton primary ions. The origin of the vesidual nitrogen ionization was investigated. Author

N70-40249# Harvard Univ., Cambridge, Mass. Acoustics Research Lab.
[ACOUSTICS RESEARCH BIBLIOGRAPHY AND PERSONNEL AND COST REPORTS] Final Report, 1946–1970
Frederick V. Hunt 30 Jun. 1970 127 p refs
(Contract N00014-67-A-0298-0007)
(AD-708758) Avail: NTIS CSCL 20/1

The report is a discursive commentary on the Harvard program of acoustics research that has been supported continuously by ONR since 1946. The final reports on the two predecessor contracts are updated and reviewed, and the plans for phasing out the current contract during 1970-1971 are outlined. Several enclosures provide summary information for the period 1946-1970, including a consolidated staff roster, biographical sketches of the degree-winners and the professional staff, a summary listing of the Technical Memoranda issued, and an updated bibliography of the external communications by staff members. Author (TAB)

N70-40256# Naval Research Lab., Washington, D.C. Optical Sciences Div.
ON THE LOCAL DETERMINATION OF THE DISTRIBUTION OF LIGHT AT ANY DOWNBEAM RANGE Interim Report
J. W. Tucker Jun. 1970 17 p
(AD-708685; NRL-MR-2133) Avail: NTIS CSCL 20/6

The expansion of the diffraction integral for a beam of light shows that the distribution of light at any point in the beam may be determined locally from that at the appropriate point in the converging cone of light from a lens or optical system. It is shown that this is an imaging process in which the downbeam point is treated as a virtual source. Author (TAB)

N70-40284# Brown Univ., Providence, R.I. Div. of Engineering.
GUIDED SURFACE WAVES ON AN ISOTROPIC ELASTIC HALF-SPACE
L. B. Freund May 1970 31 p refs
(Contract ARPA SD-86)
(AD-707079; ARPA-E72) Avail: NTIS CSCL 20/1

Three-dimensional wave propagation in an elastic half-space is considered. The half-space is traction free on half its boundary, while the remaining part of the boundary is free of shear traction and is constrained against normal displacement by a smooth, rigid barrier. A time-harmonic surface wave, traveling on the traction free part of the surface, is obliquely incident on the edge of the barrier. The amplitude and the phase of the resulting reflected surface wave are determined by means of Laplace transform methods and the Wiener-Hopf technique. Wave propagation in an elastic half-space in contact with two rigid, smooth barriers is then considered. The barriers are arranged so that a strip on the surface of uniform width is traction free, which forms a waveguide for surface waves. Results of the surface wave reflection problem are then used to geometrically construct dispersion relations for the propagation of unattenuated guided surface waves in the guiding structure. The rate of decay of body wave disturbances, localized near the edges of the guide, is discussed. Author (TAB)

N70-40333# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
VIBRATION OF CAVITATING HYDROFOILS Final Report, 1 Oct. 1967–30 Jun. 1969
Charles C. S. Song Oct. 1969 42 p refs
(Contract N00014-67-A-0113-0005)
(AD-708573; Rept-3) Avail: NTIS CSCL 13/10

A primarily experimental research program was carried out using a free-jet water tunnel for the purpose of studying force and moment fluctuations on cavitating two-dimensional hydrofoils. Both a symmetrical wedge and a non-symmetrical wedge were tested for a wide range of cavity lengths and several different elastic conditions. Fluctuations in lift and moment were of primary concern in the experiments. It was revealed that the force and moment were quite steady if the cavity was longer than two chords unless an excessive amount of ventilation caused cavity pulsations. For a shorter cavity, however, the flow was generally very unstable, and severe vibrations were noted. A cavity of any length was found to be basically unstable and to oscillate at a characteristic frequency which was primarily a function of the cavity length. The vibrating cavity may cause an elastically supported foil to vibrate severely when the cavity is short. The largest-amplitude vibration often occurred when the cavity length was approximately equal to one chord. Flutter-like vibrations were observed in the first and second natural modes of the two-degree-of-freedom system. The frequency of these vibrations was found to be practically independent of the cavity length. The severest vibration in the first natural mode usually occurred when the average velocity length was approximately equal to a chord, whereas vibration in the second natural mode was more likely to occur when the cavity was very short. Author (TAB)

N70-40334# Naval Research Lab., Washington, D.C. Shallow Water Observance Branch.
AN EXPERIMENT ON ACOUSTIC REFLECTION FROM THE SEA SURFACE Final Report
Raymond H. Ferris and William A. Kuperman 28 May 1970 18 p ref
(AD-708684; NRL-7075) Avail: NTIS CSCL 20/1

An experiment on underwater acoustic reflection from the oceans surface was conducted in a water depth of 32 m by utilizing an omnidirectional, 3.5-kHz fixed source at a submerged depth of 16 m. Two-cycle pulses at a repetition rate of 10 pulses per second were received on a hydrophone suspended at a depth of 10.7 m from a small boat. Underwater grazing angles ranged from 15 to 40 degrees. Surface reflection loss was observed to vary over a range of approximately 20 dB with periods closely associated with the predominant water wave periods. Surface reflection gains of up to 5 dB occurred frequently. The average loss ranged from 1 dB at a grazing angle of 15 degrees to 4 dB at an angle of 40 degrees, with only a slight dependence on direction of propagation relative to the direction of the sea. Signals propagated via the surface-reflected path, when correlated with signals propagated via the direct path, exhibited an average peak value of normalized cross correlation of 0.95. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N70-39005# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
ON THE POSSIBILITY OF STUDYING THE DIFFERENCE BETWEEN PROTON AND NEUTRON DISTRIBUTIONS IN NUCLEI BY QUASI-FREE SCATTERING REACTIONS
N. M. Kabachnick 8 Sep. 1969 14 p refs
(ISS-69/34) Avail: NTIS

The possibility of studying the difference between proton and neutron distributions in nuclei by means of (e,e p) and (e,e n) quasi-free reactions, is suggested and analized. Author

N70-39024 Arizona Univ., Tucson.
A THEORETICAL STUDY OF A SYSTEM OF INTERACTING BOSONS AT LOW TEMPERATURES
James Shephard Spratt, Jr. (Ph.D. Thesis) 1969 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18391

A self-consistent field approach is developed for truncating the infinite set of equations obtained in applying the equation of motion method to interacting systems. The operator which is assumed to create elementary excitations in the system is expanded in terms of simpler operators. The method is applied to a system of Bosons at low temperatures in the approximation that the interaction is both temperature and density independent. Corrections to the pairing approximation are obtained due to the inclusion of more terms in the Hamiltonian and the inclusion of collective excitations. A collective excitation is considered for the zero momentum excitation and it is found that its energy must be nonzero. The application to superfluid He-4 is discussed. Dissert. Abstr.

N70-39030 Florida State Univ., Tallahassee.
NUCLEAR STRUCTURE OF Sm-153, Gd-155, Gd-157, AND Gd-159
Yoshijiro Shida (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-17685

The energy levels in Sm-153, Gd-155, Gd-157, and Gd-159 were investigated by means of Sm and Gd reactions with deuterons yielding tritons or protons. The reactions were studied at 12 MeV deuteron energy with a magnetic spectrograph. Cross sections were analyzed in the D.W.B.A. theory of the stripping and pickup reactions spectroscopic factors were extracted. The study of proton angular distributions has led to the determination of transferred orbital angular momenta. The results are used to identify states with the Nilsson orbitals; 14 different orbitals are observed in these nuclei and assignments of two beta-bands in Sm-155 and Gd-155 are suggested. Comparisons of the spectroscopic factors with the two theoretical predictions, the Nilsson potential and the deformed Saxon-Woods potential, has shown the latter potential to be the preferred one. Single particle energy ordering and band head energy systematics were in good agreement with the predictions of both potentials except for the orbitals originating from the 82 neutron shell. Effects of the hexadecapole deformation upon the single particle orbitals are examined for the Sm and Gd isotopes. Dissert. Abstr.

N70-39038# Syracuse Univ., N.Y. Dept. of Physics.
INTEGRAL INEQUALITIES FOR THE s- AND p-WAVE 2 PION PARTIAL-WAVE AMPLITUDES DUE TO CROSSING SYMMETRY AND POSITIVITY
A. P. Balachandran and Maurice L. Blackmon Mar. 1970 7 p refs Sponsored by AEC
(SU-1206-223; NYO-3399-223) Avail: NTIS

An infinite number of inequalities for the s- and p-wave pion pion scattering amplitudes are derived. They follow from crossing symmetry and from the positivity of the even $1 >$ or $=$ to 2 partial waves of the reactions 2 neutral pions yield neutral pion and positive pion, negative pion yield positive pion negative pion in the region $0 <$ or $=$ to $s <$ or $=$ to $4m^2$ sub pi. Author (NSA)

N70-39040 Rice Univ., Houston, Tex.
THE STATISTICAL MECHANICAL DERIVATION OF THE HYDRODYNAMIC EQUATIONS FOR A SYSTEM OF SPHERICAL MOLECULES
Bruce Neil Miller (Ph.D. Thesis) 1969 51 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19320

The equations of hydrodynamics are derived from the principles of classical statistical mechanics for a single component system of spherical molecules. Exact expressions for the stress tensor and heat flux are obtained without restoring to any methods of approximation. The derivations are carried out for a system of molecules which interact through a continuous pair potential, and for a system consisting solely of rigid spheres. The long wavelength expansion employed by Irving and Kirkwood in expressions for the stress tensor and heat flux is examined. It is demonstrated that this expansion converges only if the intermolecular potential goes to zero faster than any positive of $(1/r)$ in the limit of large r (r is the internuclear distance) and hence is of questionable value for any realistic intermolecular potential. An elementary example is considered to demonstrate the effect of finite wavelength on the stress tensor. Dissert. Abstr.

N70-39071# Gulf General Atomic, San Diego, Calif.
INTEGRAL NEUTRON THERMALIZATION Quarterly Progress Report, 1 Oct.–31 Dec. 1969
E. L. Slaggie, G. M. Borgonovi, D. H. Houston, and J. M. Neill 7 Jan. 1970 18 p refs
(Contract AT(04-3)-167)
(GA-9901) Avail: NTIS

Research progress on integral neutron thermalization studies is reported. The studies include use of the FLANGE 1 and FLANGE 2 codes for extracting data from the ENDFIB file, spectrum measurements of plutonium nitrate, energy mesh selection and thermal benchmark calculations, and ENDF-related activities. NSA

N70-39072# California Univ., Berkeley. Lawrence Radiation Lab.
THE TRIPLE-REGGE VERTEX
Michael Norman Misheloff (Ph.D. Thesis) 28 Apr. 1970 54 p refs
(Contract W-7405-eng-48)
(UCRL-19795) Avail: NTIS

A Reggeized model is developed for the 3-to-3 amplitude using group theoretical variables. The triple-Regge vertex is defined by the asymptotic form of the amplitude. It is defined entirely in terms of physical region quantities and therefore is, in principle, directly measurable. Author (NSA)

N70-39074# Los Alamos Scientific Lab., N.Mex.
APPROXIMATION FOR THE INVERSE OF THE KLEIN-NISHINA PROBABILITY DISTRIBUTION
C. J. Everett and E. D. Cashwell Jun. 1970 4 p refs
(Contract W-7405-eng-36)
(LA-4448) Avail: NTIS

Approximate formulas, convenient for machine computation, and required in Monte Carlo practice, are given for the inverse of the Klein–Nishina probability distribution, permitting the direct determination of the energy E' of a Compton-scattered photon, from a uniformly distributed random number. The relative error does not exceed 3.2% over the range 0.001 less than or equal to E less than 100 MeV of incident photon energies, and is usually much less, being at most 1%, for example, when E' is less than or equal to .3E and E/sq mc is greater than 4. Author (NSA)

N70-39079# Iowa State Univ. of Science and Technology, Ames.
ANTIPROTON-PROTON ANNIHILATION INTO FOUR AND FIVE PIONS AT 2.4 AND 2.9 GeV/c
Ronald Paul Radlinski (Ph.D. Thesis) Feb. 1970 94 p refs
(Contract W-7405-eng-82)
(IS-T-358) Avail: NTIS

From a sample of 16,000 four-pronged events from antiproton proton interactions at 2.4 GeV/c and 9,400 at 2.9 GeV/c, a study of resonance production and angular distributions was made for the constrained reactions antiproton proton yields 2 positive pions 2 negative pions (neutral pion). Evidence for a f(0)pion resonance of mass 1700 MeV/sq c in the four pion channel and for B meson production in the five pion channel was found at 2.4 GeV/c. In the center-of-mass system, the tendency for the negative pion (positive pion) to be produced in the direction of the antiproton (proton) decreased with increased multiplicity and increased at the higher momentum. The deviations of the distributions of the center-of-mass angle between pairs of pions from Lorentz phase space predictions were, in general, smaller at 2.9 GeV/c than 2.4 GeV/c. The production and decay angular distributions of resonance particles were also investigated. Author (NSA)

N70-39110# Kernforschungszentrum, Karlruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
INSTABILITY AND ACCEPTANCE FOR PARTICLE BEAMS IN LINEAR ACCELERATORS WITH BETWEEN-TANK FOCUSING
C. Passow Oct. 1969 47 p refs In GERMAN
(NP-18230) Avail: AEC Depository Libraries

In superconducting accelerators focusing lenses have to be inserted between the accelerating tanks, otherwise the influence of the magnetic fields deteriorates the superconducting properties of surface. The problems of longitudinal and transversal stability of particle trajectories have been studied for such a system. It turns out that longitudinal and transversal instabilities occur for certain combinations of tank length and spacing. It is shown that a lower accelerating frequency provides longer accelerating tank sections. In addition, a much higher acceptance can be achieved. Author (NSA)

N70-39122# Kansas Univ., Lawrence. Nuclear Physics Div.
COMPARISON OF ASYMMETRIC SHAPES FOR DEFORMED NEGATIVE PARITY STATES IN HEAVY EVEN NUCLEI
M. G. Davidson [1969] 19 p refs
(Contract AT(11-1)-1120)
(COO-1120-94) Avail: NTIS

Asymmetric collective models with pure quadrupole, pure octupole, and mixed quadrupole plus octupole shapes are developed for negative parity states in deformed even nuclei in an effort to determine whether the other shapes offer as good a fit to data as the octupole shape usually assumed. The comparison is made of the energy levels and E2 branching ratio of Th-228, U-232, and U-234. It is found that while there are some differences between the models, no clear distinction can be made with existing data. Author (NSA)

N70-39123# California Univ., Berkeley. Lawrence Radiation Lab.
PROSPECTS FOR SUPER HEAVY NUCLEI
W. J. Swiatecki 25 Jul. 1969 40 p refs Presented at the Intern. Conf. on Nucl. Reactions Induced by Heavy Ions, Heidelberg, 15–18 Jul. 1969
(Contract W-7405-eng-48)
(UCRL-19405; Conf-690707-4) Avail: NTIS

The use of heavy ions to form super-heavy elements is discussed. A macroscopic approach to heavy ion and fission physics is promoted as the appropriate starting point for the formation. The two principal difficulties emphasized are making the neutron to proton ratio approximately 184/110 and making the reaction gentle enough to avoid shattering the extremely brittle super-heavy nucleus. NSA

N70-39128 Purdue Univ., Lafayette, Ind.
A MEASUREMENT AND ANALYSIS OF THE ELASTIC AND INELASTIC SCATTERING OF 18.4-MeV ALPHA PARTICLES BY F-19 NUCLEI
Charles Lynn Wiley (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-17291

The angular distributions corresponding to the F-19 (alpha, alpha') F^{*}-19 reactions leading to the ground and first five excited states in the F-19 nucleus were determined at 5 deg intervals over the range of angles from 15 deg to 155 deg, measured in the laboratory frame of reference. The targets, very thin, self-supporting films of a fluorinated hydrocarbon, were fabricated at this laboratory; the average incident-particle energy at mid-target was 18.40 MeV. The six lowest-lying levels in the F-19 nucleus fall into two natural groups, each containing three levels spaced approximately 100 keV apart. Because of this small level spacing, it was necessary to use the Purdue broad-range magnetic spectrograph to obtain the high resolution required for this experiment. Dissert. Abstr.

N70-39131# Battelle-Northwest, Richland, Wash. Radiological Sciences Dept.
NEUTRON SPECTRA OF PLUTONIUM COMPOUNDS. PART 1: He 3 AND Li 6 SPECTROMETER MEASUREMENTS
L. W. Brackenbush and L. G. Faust Feb. 1970 34 p refs
(Contract AT(45-1)-1830)
(BNWL-1262-Pt-1) Avail: NTIS

The neutron energy spectra of compounds of high-exposure plutonium are presented. The neutron spectrum of plutonium tetrafluoride shows a peak at 1.3 MeV, which agrees with previously published measurements; the neutron spectrum of plutonium dioxide is shown to have a very broad peak at about 2 MeV. A previously unreported spectrum of a plutonium-aluminum alloy (21 percent Pu–79 percent Al) is presented with a peak at about 1.6 MeV. The average fluence to dose conversion factors calculated from the measured spectra are given for plutonium dioxide, plutonium tetrafluoride, plutonium-aluminum alloy, and plutonium metal (spontaneous fission spectrum). Author (NSA)

N70-39142# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
VERY INTENSE NEUTRON SOURCE (VINS)
R. M. Brugger, G. J. Russell, B. W. Johnson (AEC), and G. P. De Vault (Mont. Coll. of Mineral Sci. and Technol.) Apr. 1970 53 p refs
(Contract AT(10-1)-1230)
(IN-1304) Avail: NTIS

The conceptual design of a neutron source is described. This device, called Very Intense Neutron Source (VINS) would produce bursts of neutrons to be used for fast and thermal neutron beam experiments by time-of-flight methods. The source would have an effective source flux for beam experiments several orders of magnitude above those fluxes now available at the best neutron sources. In the concept the neutrons produced by an electron linear accelerator would be multiplied by fast reactor modules. These modules would be arranged to provide maximum multiplication While limiting the shock and heat and limiting multiplication of those neutrons from the delayed neutron precursors. The experimental arrangement and uses of VINS are stressed. Author (NSA)

N70-39143# Los Alamos Scientific Lab., N.Mex.
MODEL FOR THE OPTICAL POTENTIAL OF COMPOSITE PARTICLES
P. W. Keaton, Jr., E. Aufdembrink, and L. R. Veeser Feb. 1970 64 p refs
(Contract W-7405-eng-36)
(LA-4379) Avail: NTIS

A model for optical potentials of composite particles is studied. Individual nucleon optical potentials are averaged over the internal motion of deuterons and tritons (or He-3) with realistic wave functions. Analytic expressions are developed for form factors predicted. Results of some specific calculations with the model are presented. Author (NSA)

N70-39144# California Univ., Berkeley. Lawrence Radiation Lab.
ELECTRON IMPACT EXCITATION OF HEAVILY IONIZED ATOMS
Mehdi Golshani 26 Feb. 1970 41 p refs
(Contract W-7405-eng-48)
(UCRL-19712) Avail: NTIS

The Coulomb-Born approximation is used to calculate the total cross section for the electronic excitation of ionized atoms. When the incident energy is high and the atom is highly ionized, the eikonal and classical approximations can be used simultaneously. In this case the scattering amplitude reduces to a one-dimensional path integral. The path inetegral, in turn, can be reduced, to any desired accuracy, to a sum over integrals that can be done analytically. This procedure was used to calculate the total cross sections for the heavily ionized atoms Fe-16(+), Co-15(+), Ni-17(+), and Cu-18(+). Author (NSA)

N70-39146# Brookhaven National Lab., Upton, N.Y.
EPITHERMAL NEUTRON CAPTURE GAMMA RAYS
R. E. Chrien [1970] 30 p refs Presented at the IAEA Meeting on Res. Reaction Util., Rome, 2 - 6 Feb. 1970 Sponsored by AEC
(BNL-14468; Conf-700204-1) Avail: NTIS

The use of epithermal capture as a spectroscopic tool is discussed and its advantages are presented. Examples of the two kinds of epithermal experiments are discussed: diffraction methods, which can be used to follow the transition probability as a detailed function of neutron energy, and filtered beam methods, which can be used to obtain broad energy averages over the initial states in an effort to obtain a more equal population of final states than is achieved in thermal capture. NSA

N70-39153# Hamburg Univ. (West Germany).
INSTITUTE OF EXPERIMENTAL PHYSICS Annual Report, 1968
Feb. 1970 79 p refs In GERMAN
(BMBW-FBK-70-3) Avail: AEC Depository Libraries

Concerning nuclear physics investigations, stress is laid mainly on nuclear spectroscopy and the study of nuclear reactions. These experiments are performed with a 3 MeV van de Graaff generator and by means of radioactive sources. High energy physics is investigated especially by analysis of photographs taken in the bubble chambers and by studies of production processes of elementary particles, both in connection with Deutsches Elektronen-Synchrotron (DESY). Author (NSA)

N70-39154# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.
MEASUREMENT OF AND CALCULATION OF STRENGTH FUNCTION VALUES FOR NUCLEI IN THE AREA OF 3s RESONANCE
K.-N. Nueller and G. Rohr Nov. 1969 76 p refs In GERMAN
(KFK-1114) Avail: AEC Depository Libraries

Total neutron cross sections of the isotopes Ti-49 and Cr-53 were measured in the energy range of 17-250 keV at the Karlsruhe Van de Graaff accelerator, and analyzed with an R-matrix multilevel formula to obtain the resonance parameters. A spin-independent strength function value of 3.2 + or - 0.7 was obtained for Ti-49 and 4.1 + or - 0.9 for Cr-53. The analysis of the cross section above 120 keV indicates a spin dependence of the Cr-53 strength function. To investigage the fluctuations of experimental strength function values around the average curve described the optical model, strength functions were calculated for 20 nuclei in the region of the 3 s resonance. The calculations are based on a semi-empirical ansatz and explain the density of these states was calculated in the framework of a shell model. Pairing correlations were taken into account according to the superconductivity theory of the nucleus. Author (NSA)

N70-39174# Lund Univ. (Sweden). Dept. of Nuclear Physics.
HIGH ENERGY PHOTOFISSION CROSS SECTIONS OF URANIUM AND THORIUM
T. Methasiri and S. A. E. Johansson Apr. 1970 18 p refs
(LUNP-7005) Avail: AEC Depository Libraries

The photofission cross sections of uranium and thorium were measured in the bremsstrahlung energy range 200 to 900 MeV. A glass detector was used to detect the fission fragments. Fission cross sections were obtained from the integrated cross section using Penfold and Leiss's method. It was found that the photofission cross sections of both uranium and thorium show resonance peaks at a photon energy of 350 MeV, with peak values of 80 and 60 mb respectively. It is suggested that in a high energy fission, the fission mechanism can, at least in part, be due to photo meson production processes. Author (NSA)

N70-39175# Institute of Nuclear Research, Warsaw.
ISOMERIC CROSS SECTION RATIOS AND TOTAL CROSS SECTIONS FOR THE Se 74/n,2n/73g,m Se, Zr 90/n,2n/89g,mZr AND Mo 92/n,2n/91g,m Mo REACTIONS
A. Abboud, P. Decowski, W. Grochulski, A. Marcinkowski, J. Piotrowski et al 1969 33 p refs
(INR-P-1105) Avail: AEC Depository Libraries

The isomeric ratios and excitation functions were measured for the Se-74/neutron, 2 neutrons/Se-73g,m, Zr-90/neutron, 2 neutrons/Zr-89g,m, and Mo-92/neutron, 2 neutrons/Mo-91g,m reactions in the neutron energy range 12-18 MeV. The results are compared with the statistical model predictions. Calculations were performed with the use of the superconductivity model of nuclear level density for closed shell nuclei. In the case of the Zr-90/neutron, 2 neutrons/Zr89g,m and Mo-92/neutron, 2 neutrons/Mo-91g,m reactions the calculated isomeric ratios show good agreement with experimental data, which is not true, however, for Se-74/neutron, 2 neutrons/Se-73 g,m, reaction. To obtain agreement between

the experimental and theoretical isomeric ratios for the latter reaction some changes in the decay scheme of the Se-73 nucleus seem to be necessary. For all the reactions investigated the calculated total cross sections do not agree with the measured ones. The disagreement may be due to the fact that no account was taken of the gamma-neutron competition. Author (NSA)

N70-39176# Institute of Nuclear Research, Warsaw.
CROSS SECTIONS FOR THE Y 89 (n,n') Y 89m AND Y 89(n,2n) Y 88 REACTIONS
A. Abboud, P. Decowski, W. Grochulski, A. Marcinkowski, K. Siwek et al 1969 12 p refs
(INR-1147) Avail: AEC Depository Libraries

The excitation curves for the Y-89 (neutron,neutron')Y-89m reaction were measured in the neutron energy range 3 to 18 MeV, and for the Y-89 (neutron,2 neutrons)Y-88 reaction in the energy range 13 to 18 MeV. The results obtained were interpreted in terms of the statistical nuclear reaction model. The problem of competition of the electromagnetic radiation emission with respect to the neutron emission from the highly excited compound nucleus states is discussed. Author (NSA)

N70-39186# Georgia Inst. of Tech., Atlanta. School of Physics.
FORMATION AND DESTRUCTION OF EXCITED HYDROGEN ATOMS AT HIGH IMPACT VELOCITIES
J. L. Edwards and E. W. Thomas 13 Jun. 1970 115 p refs Submitted for publication
(Contract AT(40-1)-2591)
(ORO-2591-47) Avail: NTIS

A study was made of the charge-transfer processes whereby fast, neutral atoms of hydrogen are formed in the 3s, 3p, and 3d excited states as a result of the impact of protons on targets of helium and nitrogen. The procedure involved quantitative measurement of the Balmer alpha radiation emitted in spontaneous decay of the excited atoms. The fact that the 3s, 3p, and 3d states have substantially different lifetimes permitted the use of a time-of-flight technique to identify separately their contributions to the emission. Detailed measurements of the collisional formation and destruction processes are presented for targets of He and N2 for impact energies from 75 to 400 keV. The cross section for capture into the 3s state is by far the largest of the three capture cross sections and is larger for a nitrogen target than for helium. Cross sections for capture into the 3p and 3d states are one to two orders of magnitude smaller, but the fraction of the atoms formed in the p and d states is slightly larger in nitrogen than in helium. Author (NSA)

N70-39192# Lund Univ. (Sweden).
HIGH ENERGY PHOTON INDUCED SPALLATION REACTIONS IN I 127
G. G. Jonsson and B. Persson Mar. 1970 41 p refs
(LUNP-7004) Avail: AEC Depository Libraries

The yields for 28 different I-127(gamma,yp xn) reactions were measured by activation analysis from their thresholds up to 1 GeV. The mean cross sections in the energy region 250 - 900 MeV were determined. Photon and particle induced spallation cross section distributions were compared using a five parameter formula given by Rudstam and the significance of the different parameters is discussed. The mean total high energy cross section was compared to the total free-nucleon photo-pion cross section. Some calculations on the basis of the cascade-evaporation model were carried out. Finally the empirical cross section formula was used to estimate some photon induced spallation cross sections. Author (NSA)

N70-39193# Uppsala Univ. (Sweden). Inst. of Physics.
LIFETIMES OF EXCITED STATES IN Sb-119
K. G. Vaelivaaks Nov. 1969 9 p refs
(UUIP-672) Avail: AEC Depository Libraries

The lifetimes of three excited states Sb-119 were measured by delayed coincidence technique. The results are the 270.3 keV level: half life time = 10 + or - 9 ps; the 1212.6 keV level half life time = 46 + or - 8 ps; the 1365.8 keV level: half life time < or = to 330 ps. Author (NSA)

N70-39194# California Univ., Livermore. Lawrence Radiation Lab.
COMPILATION OF X-RAY CROSS SECTIONS, SECTION 1
W. H. McMaster, N. Kerr Del Grande, J. H. Mallett, and J. H. Hubbell Jan. 1970 18 p refs
(UCRL-50174-Sect-1) Avail: NTIS

Graphs and tables of X-ray cross sections in the range of 1 keV to 1 MeV are included. The total cross sections presented are the sum of computed scattering cross sections and a combination of the fit to derived experimental and theoretical photoelectric cross sections. Author (NSA)

N70-39198# Addis Translations International, Woodside, Calif.
FORMATION OF SHOWERS IN RESCATTERINGS AND THE GROWTH OF THE TOTAL CROSS-SECTIONS AS E APPROACHES INFINITY
A. I. Lendel et al [1969] 9 p refs Transl. into ENGLISH from Akad. Nauk UKR. SSR, Inst. Teor. Fiz. (Kiev), 1969 p 1 - 12
Prepared for Stanford Linear Accelerator Center
(SLAC-Trans-112) Avail: NTIS

The data on the total cross sections obtained at the Serpukhow accelerator are discussed. It is shown that the good agreement with the experiment can be obtained in frame of the complex momentum theory if the effect of the showers production at rescattering is taken into account. Author (NSA)

N70-39200# California Univ., Livermore. Lawrence Radiation Lab.
FOUR-PARAMETER MEASUREMENTS OF DELAYED GAMMA RAYS FROM SPONTANEOUS FISSION OF Cf 252
Frank W. Guy (Ph.D. Thesis) 2 Feb. 1970 97 p refs
(UCRL-50810) Avail: NTIS

In this experiment, the energies, half-lives and intensities of 144 gamma-ray transitions following Cf-252 fission were measured, and the masses of the emitting fragments were determined. The experiment covered a time range of 5 to 2000 nsec and a gamma-ray energy range of 90 to 2860 keV. A Cf-252 fission source on a thin foil was placed between two silicon fission-fragment detectors; a Ge(Li) gamma-ray detector was exposed to one fragment detector. For each triple-coincidence event, the three detector pulse heights and the electronically measured delay time were recorded. Fragment masses were calculated from fission-fragment-detector pulse heights. Most masses produced delayed gamma rays; however, the intensity varied greatly from mass to mass. The total delayed spectrum showed a low-energy component peaking at 100 to 150 keV and a high-energy component consisting of a few transitions in the 1300-keV range. Author (NSA)

N70-39225# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
GUNYA: A CODE FOR GENERATING NEUTRON CROSS SECTIONS
H. D. Ferguson Nov. 1969 42 p refs
(AAEC-TM-520) Avail AEC Depository Libraries

A description is given of GUNYA, a computer code for the preparation of group-averaged neutron cross sections for the six reactions (neutron,gamma), (neutron,fiss), (neutron,abs), (neutron,nubar-fiss), (neutron,trans), (neutron,2 neutrons) as well as resonance shielding parameters, in a form suitable for use in conjunction with GYMEA, a neutronics code in use by the A.A.E.C.

The data requirements and the single-level resolved and statistical resonance theory employed are described. Point cross sections can be averaged over an integrated fission and slowing down spectrum. Cross sections and shielding parameters can be produced for both single nuclides and natural elements. An unlimited number of nuclides/natural elements can be processed in a single run and a comprehensive range of options allows flexibility of input, execution and output. The code is written in FORTRAN 4 and is intended for an IBM 360. NSA

N70-39228# California Univ., Berkeley. Lawrence Radiation Lab. Dept. of Chemistry.
WEAK INTERACTION STUDIES BY NUCLEAR ORIENTATION
William D. Brewer (Ph.D. Thesis) Dec. 1969 210 p refs
(Contract W-7405-eng-48)
(UCRL-19533) Avail: NTIS

The technique of low temperature nuclear orientation was applied to two problems involving weak nuclear decays. Nuclei of Sb-119 were polarized in an iron lattice and the angular distribution of inner bremsstrahlung photons emitted during the electron capture decay was observed. The distribution fit the correlation function and the asymmetry coefficient had the theoretical value of +1.0 near the spectrum endpoint. However, some energy dependence of A sub 1 was observed, in contrast to theoretical expectations. Possible origins of the energy dependence are discussed. Nuclear orientation was also carried out with three isotopes which undergo 1st forbidden beta decays: Re-186, Re-188, and Ir-194. The source nuclei were polarized in iron lattices and the angular distributions of both beta particles and gamma rays were observed. Lithium-drifted germanium counters were used to detect the beta particles. Author (NSA)

N70-39238 Rice Univ., Houston, Tex.
STUDIES IN MICROWAVE SPECTROSCOPY: METHYLAZIDE AND A STARK AND ZEEMAN MODULATED FABRY-PEROT RESONATOR FOR THE STUDY OF UNSTABLE MOLECULES
William Michael Salathiel (Ph.D. Thesis) 1969 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-19331

The microwave spectrum of methylazide (CH_3N_3) has been investigated, and a- and b-type transitions assigned. The dipole moment has been found to be 2.17 + or − 0.025 D. The barrier to internal rotation of the CH_3 group has been found to be 714 + or − 20 cal/mole. A mm-wave spectrometer has been constructed to study unstable molecules. The spectrometer employs a Fabry-Perot resonator to a fast-flow vacuum system. The design and construction of the spectrometer is presented. Examples of the spectrometer operation using video display, Stark modulation, and Zeeman modulation are given. Dissert. Abstr.

N70-39240 Purdue Univ., Lafayette, Ind.
LAMBDA HYPERON FINAL STATES FROM THE INTERACTION OF K (-) MESONS ON DEUTERIUM AT 4.5 GeV/c
Wen Liang Yen (Ph.D. Thesis) 1969 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-17299

The results presented in this paper were obtained from an analysis of 372,000 negative K meson deuterium bubble chamber pictures at an incident negative K meson momentum of 4.5 GeV/c. The differential cross section and polarization of the Lambda hyperon in the reaction negative K meson neutron yields negative pion Lambda hyperon has been determined and compared with the double-Regge-pole model of Reeder and Sarma. The model predicts the differential cross section quite accurately and a dip occurs in the experimental distribution near t = -.4(GeV/c) to the 2nd power. The polarization was found to be large and remains more or less constant with a value of 0.6 + or − 0.2. No change in sign was observed in contrast with the prediction of the model of Reeder and Sarma. A common feature of the observed two body final states is that their production process is dominated by a peripheral mechanism which arises from meson exchange processes. The exchange mechanism for the reaction negative K meson neutron yields negative rho meson Lambda hyperon was investigated in terms of the density matrix formalism. It was found that more than one exchange contributes to the production of this final state. Dissert. Abstr.

N70-39245# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
NUCLEAR STRUCTURE WITH REALISTIC INTERACTIONS: A SURVEY OF METHODS AND RECENT RESULTS
M. Baranger Oct. 1969 51 p refs Presented at 8th Eastern Theoret. Phys. Conf., Syracuse, N.Y., 1969
(Contract AT(30-1)-2098)
(MIT-2098-593; CONF-691033-1) Avail: NTIS

Realistic two-nucleon interactions are mentioned, and the methods of solution are discussed. The methods included are Feynman diagrams, Brueckner's use of the T matrix and the G matrix, the Goldstone expansion, the BBP theorem, particle spectrum and 3-body diagrams, Brueckner-Hartree-Fock calculations, shell model calculations, and folded diagrams. The results of these methods are discussed. NSA

N70-39263# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
DIFFUSIVE SLOW NEUTRON SCATTERING LAW
L. R. Clifford Jan. 1970 31 p refs
(Contract AT(07-2)-1)
(DP-1224) Avail: NTIS

The diffusive center of mass motion of particles is derived by assuming that the particles are coupled to a heat bath by a dipole interaction. Both the particles and the bath are treated as quantum mechanical systems. The equations of motion are obtained by using a perturbation method which describes dissipative effects in quantum mechanics. The diffusive slow neutron scattering law for the center of mass motion of particles in a liquid is then derived in the incoherent approximation. The scattering law satisfies the principle of detailed balance and the zeroth and first energy transfer moment theorems. The scattering law is expressed as a series of incomplete gamma functions and is evaluated in that form. Author (NSA)

N70-39264# Lund Univ. (Sweden). Dept. of Physics.
ANGULAR DISTRIBUTIONS IN HIGH ENERGY PHOTOFISSION OF GOLD AND LEAD
Ingvar Kroon and Bengt Forkman Feb. 1970 20 p refs
(LUNP-7003) Avail: AEC Depository Libraries

The angular distributions of fragments in photofission of gold and lead were measured in the bremsstrahlung energy range 350-1000 MeV. Glass detectors were used for measurements; angular distributions were nearly isotropic in the laboratory system with a small but significant forward peaking. This anisotropy is supposed to be an effect of nuclear motion. NSA

N70-39265 Rice Univ., Houston, Tex.
THE ELASTIC SCATTERING OF PROTONS AND DEUTERONS FROM DEUTERIUM: THE REACTIONS H-2(p,p)H-2 AND H-2(d,d) H-2 AND NEUTRON-PROTON COINCIDENCE MEASUREMENTS IN THE REACTION Be-9(p,pn) Be-8
Arthur Seymour Wilson (Ph.D. Thesis) 1969 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-19340

A Van de Graaff accelerator and a precision small volume gas scattering chamber were used for the investigation. For p-d data, excitation curves were taken at 45.26 deg, 90.26 deg, and 118.92 deg c.m. for lab proton energies from 4.5 to 11.4 MeV.

Angular distributions were taken at 4.45, 5.45, 6.50, 7.46, 8.47, 9.47, 10.47, and 11.47 MeV from 30 deg to 140 deg c.m. For d-d data, excitation curves were taken at 60 deg and 90 deg c.m. for lab deuteron energies from 35. to 12.25 MeV. Angular distributions were taken at 4.46, 5.46, 6.47, 8.51, 9.53, 10.55, and 11.57 MeV from 40 deg to 97.5 deg c.m. Excitation curves were taken in 20 or 50 keV (lab) steps; angular distributions were taken in 2 1/2 deg or 4 deg c.m. steps. Neither the p-d nor the d-d exhibit significant anomalies. Therefore the present data yield no evidence for the existence of excited states in He-3 between 8.5 and 13.1 MeV excitation with isospin T = 1/2 or possibly T = 3/2; nor for the existence of excited states in He-4 between 25.55 and 29.66 MeV excitation with isospin T = 0. Dissert. Abstr.

N70-39273# Brookhaven National Lab., Upton, N.Y. Information Div.

NEW NEUTRON DEFICIENT ISOTOPES OF Hf 169, Hf 167, Hf 166, and Lu 166. DECAY SCHEME OF Hf 169

R. Arlt et al Apr. 1970 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR Ser. Fiz. (Moscow), v. 33, Aug. 1969 p 1232–1243

(BNL-tr-347) Avail: NTIS

The basic characteristics of short-lived neutron-deficient Hf isotopes were studied, and it is shown that the Hf-169 and Hf-167 isotopes were previously identified incorrectly. The half life for Hf-169 was found to be 3.2 + or − 0.1 min and for Hf-167 T sub 1/2 = 1.9 + or − 0.2 min. (NSA)

N70-39300 Carnegie-Mellon Univ., Pittsburgh, Pa.

A RECOIL STUDY OF (p,n) AND (p,2n) REACTIONS FOR PROTON BOMBARDING ENERGIES OF 100 TO 400 MeV

Allan Cecil Stalker (Ph.D. Thesis) 1969 100 p

Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-19109

Investigators have been speculating about the mechanism for simple nuclear reactions in the incident particle energy region of 100 to 400 MeV. Of the nucleon-2 nucleon reactions the (p,2n) reaction offers the fewest complications for determining reaction mechanism. The two possible mechanisms are thought to be a cascade neutron followed by the evaporation of a second neutron or two cascade neutrons leaving the residual nucleus with excitation energy insufficient for further particle evaporation. A kinematic model for simple nuclear reactions, KMSNR, was developed and compared to the experimental work. Based on the results of the comparison of two calculation models with the experimental data it is concluded that the charge exchange scattering mechanism followed by evaporation of a neutron is the more dominant mechanism with light A nuclides and that multiple scattering with two cascade neutrons increases in importance with increasing A. Dissert. Abstr.

N70-39301# Institute of Nuclear Research, Warsaw (Poland).

STATISTICAL MODEL AND CROSS SECTION FOR HIGH-ENERGY REACTIONS [MODEL STATYSTYCZNY I PRZEKROJE CZYNNE REAKCJI WYSOKICH ENERGII]

Jerzy Bartke 1970 101 p refs In POLISH

(INR-1163) Avail: AEC Depository Libraries

The application of the statistical model to the calculation of cross sections for high-energy reactions is discussed. Comparison with experimental data includes various many-body and two-body reactions, and, in particular, pion-proton interactions. The discussed model is, in fact, a restricted statistical model, assuming only the independence of the reaction matrix of isospins, spins, and masses of the produced particles. The relative cross sections for different channels within a given multiplicity, as obtained from the model, are in agreement with experiment. The isospin independence of the reaction matrix may already be considered well established and this allows one to calculate the real multiplicity spectrum of the produced particles. The model should find wider application in the analysis of the cross section results, leading to better understanding of the observed dependences and to some systematics in the rapidly growing amount of experimental data. Author (NSA)

N70-39331# Stanford Research Inst., Menlo Park, Calif.

PROCESSES OF ENERGY DEPOSITION BY HEAVY PARTICLE IMPACT Technical Report, 23 Jun. 1969–23 Mar. 1970

C. Donald Lorents 25 Mar. 1970 11 p refs

(Contract AT(04-3)-115)

(SRIA-115-P-84-1; TR-1) Avail: NTIS

Preliminary results are reported for a study of K-shell excitation in collisions of Li(+) with He at primary energies up to 2000 eV. At 2000 eV energy loss spectra of the scattered L(+) ions show two prominent peaks, one at 22 eV and one at 62 eV. Plans for further measurements and for data analysis are discussed briefly. NSA

N70-39334# Bordeaux Univ. (France). Lab. de Physique Theorique.

CONSISTENCY CONDITIONS BETWEEN SU3 AND EXCHANGE DEGENERACY

M. Rimpault and Ph. Salin Mar. 1970 21 p refs

(NP-18241; Pt-34) Avail: AEC Depository Libraries

Nonexotic solutions for hadron–hadron scattering amplitudes compatible with exact SU3 symmetry and exchange degeneracy are presented and discussed. It is shown that there exist dual solutions, i.e., solutions which reproduce themselves under crossing from one channel to the others. The physical consequences predicted by these solutions are also investigated. Author (NSA)

N70-39335# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

REPRESENTATIONS OF THE LORENTZ GROUP ON THE TWO-DIMENSIONAL COMPLEX SPHERE AND TWO-PARTICLE STATES

M. Huszar and Ya. A. Smorodinskii 1970 16 p refs

(JINR-E2-5020) Avail: Depository Libraries

Two-particle spherical functions transforming according to unitary representations of the Lorentz group are constructed. Author (NSA)

N70-39340# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

THE EFFECT OF THE SPIN FORCE ON THE RATE OF ALLOWED G-T beta-DECAY IN DEFORMED NUCLEI

S. I. Gabrakov and A. A. Kuliev 1970 10 p refs In RUSSIAN

(JINR-P4-5003) Avail: AEC Depository Libraries

The effect of the charge-exchange spin-spin interaction on the rate of allowed Gamow–Teller beta-decay in odd-mass nuclei is investigated in the framework of TDA. The observed retardation of the beta-decay can be explained by such an interaction. The main part of the transition strength is expected to be distributed among high-energy excitations. Author (NSA)

N70-39345# Amsterdam Univ. (Netherlands).

BETA–GAMMA CIRCULAR POLARIZATION CORRELATION MEASUREMENT ON SOME ODD-MASS NUCLEI

Jan Johan Van Rooijen (Ph.D. Thesis) 1970 103 p refs

(NP-18213) Avail: AEC Depository Libraries

The beta–gamma circular polarization correlation measurements in Hg-203, Au-199, and Ce-141 are studied. Theoretical aspects of first-order forbidden beta decay, Compton scattering of polarized photons, polarization analyzers, and detectors electronics and corrections are considered. NSA

N70-39348 Rice Univ., Houston, Tex.

A STUDY OF THE ELASTIC AND INELASTIC SCATTERING OF PROTONS BY Ca 40

Joseph Stephen Duval (Ph.D. Thesis) 1969 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 19281

Angular distributions of the elastic protons and the inelastic protons which leave the target nucleus in its ground state and first four excited states were measured in the range of proton energies from 8.0 to 12.5 MeV at 50 KeV intervals with an experimental resolution of 30–50 KeV. The total reaction cross section for the inelastic scattering of protons by Ca-40 was also measured. The elastic angular distributions and total reaction cross sections have been analyzed by the method of phase shift analysis. Dissert. Abstr.

N70-39359# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
SOLUTION OF THE DIRECT PROBLEM OF NEUTRON GAMMA LOGGING BY A MONTE CARLO METHOD
I. G. Dyadkin et al 1968 4 p Transl. into ENGLISH from Neftegazov. Geol. Geofiz. (USSR), no. 10, 1968 p 40–41
(CSIRO-Trans-9993) Avail: AEC Depository Libraries

An algorithm to reduce time spent in examining the behavior of the dependency curve ln gamma = f(m) in the region of low porosities has been produced, taking into account the influence of most basic factors. Thermal neutron diffusion, gamma quanta of non-elastic iffusion, and pair formation influences were not taken into account. This would have been possible, but the influence was considered negligible. The particulars of the algorithm are noted, and details of the dependency of neutron logging readings on the porosity of limestone boreholes are calculated. Author (NSA)

N70-39361# European Organization for Nuclear Research, Geneva (Switzerland).
DAMPING OF COHERENT OSCILLATIONS OF A BEAM IN A STORAGE RING. 2: SYNCHROTRON PERTURBATIONS [AMORTISSEMENT DES OSCILLATIONS COHERENTES DU FAISCEAU DANS UN ANNEAU DE STOCKAGE. 2 PERTURBATIONS SYNCHROTRONIQUES]
Ya. S. Derbenev et al [1969] 23 p refs Transl. into FRENCH from Russian Preprint No. 318 In FRENCH
(CERN-Trans-70-1) Avail: AEC Depository Libraries

The possibility is studied of inventing a universal method for damping coherent phase instabilities. This is done with the help of the radiation of coherent perturbations in a doubly coupled wave guide system. The edge effects on betatron motion are considered. It is emphasized that perfectly adapted plates can induce damping as well as oscillation instability of coherent phase. NSA

N70-39362# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).
THE O(4) SYMMETRIES AND RHO MESONS PRODUCTION PROCESSES
V. S. Zamiralov 1969 17 p refs In RUSSIAN
(IFVE-STF-69-26) Avail: AEC Depository Libraries

An expansion of the helicity amplitudes of the single and coupled rho mesons and 33-isobar production amplitudes is considered assuming the little group at t = 0 being O(4). The analysis of the Regge trajectories contributions is performed taking account of their O(4)-classification. Expansions of the spin-nonflip amplitudes along the O(4) are presented which allow writing the relations of factorization. A qualitative comparison of the results with the presence of peaks in the rho meson-production experiments is made. NSA

N70-39370# Mainz Univ. (West Germany). Inst. fuer Anorganische Chemie und Kernchemie.
NEUTRON YIELDS AND NEUTRON EMISSION PROBABILITY P SUB n OF THE DELAYED NEUTRON EMITTERS IN THE FISSION OF U 235 BY THERMAL NEUTRONS [NEUTRONENAUSBEUTEN UND NEUTRONENEMISSIONS-WAHRSCHEINLICHKEITEN P SUB N VERZOEGERTER NEUTRONENSTRAHLER BEI DER SPALTUNG VON URAN-235 DURCH THERMISCHE NEUTRONEN]
Hans-Dieter Schuessler, Werner Grimm, and Guenter Herrmann [1968] 9 p In GERMAN Presented at the Profess. Comm. on Nucl. Phys., Bad Neuenahr, West Ger., 1–6 Apr. 1968
(CONF-680461-6) Avail: AEC Depository Libraries

An experimental study was made to determine the half lives and the relative contributions of the iodine and bromine fractions to the various groups of delayed neutrons in the fission of U-235 by thermal neutrons. The relative neutron yields of individual neutron emitters and their contribution to the 55, 22, 5, 2, and 0.5 sec neutron groups are tabulated. The composition of the nonhalogenide fraction and their contribution to the total delayed neutron yield were also measured. The probabilities for the neutron emission of Br-87, Br-88, Br-89, Br-90, Rb-93, Rb-94, I-137, I-138, I-139, and I-140 were calculated. NSA

N70-39371# Mainz Univ. (West Germany). Inst. fuer Anorganische Chemie und Kernchemie.
DECAY STUDIES ON SHORT-LIVED-NEUTRON-RICH NUCLIDES FROM (n,p) REACTIONS [ZERFALLSSTUDIEN AN KURZLEBIGEN NEUTRONENREICHEN MUKLIDEN AUS (N,P)-REAKTIONEN]
R. Denig, G. Herrmann, W. Herzog, N. Kaffrell, G. Rosner et al [1969] 24 p In GERMAN Presented at the Profess. Comm. on Nucl. Phys., Bad Neuenahr, West Ger., 1–6 Apr. 1968
(CONF-680461-7) Avail: AEC Depository Libraries

Decay studies were made of the neutron-rich isotopes Zr-98, Nb-98(m), Nb-98(g), Nb-99, Nb-100, Ag-113(m), Ag-114, Sb-126, Sb-128, Sb-130, Pm-154, Tb-162, Tb-163, Tb-164, Pa-235, Pa-237, and Pa-238 prepared by (n,p) reactions. The beta and gamma spectra obtained are given, and decay schemes are derived for Nb-98(m), Pa-238, Tb-162, Tb-164, and Tb-163. NSA

N70-39372# Lund Univ. (Sweden). Dept. of Physics.
ENERGY LEVELS IN Co 58
B. Erlandsson and A. Marcinkowski (Inst. of Nucl. Res., Warsaw) Nov. 1969 55 p refs
(LUNP-6907) Avail: AEC Depository Libraries

Fe-57 was bombarded with protons and 114 peaks in the yield curve for the reaction Fe-57(proton, photon)Co-58 were observed in the range of proton energy from 1150 keV to 1575 keV. Gamma ray measurements were performed with a Ge(Li) detector and the decay scheme studied with a coincidence spectrometer. A decay scheme with 30 excited levels and 52 transitions is proposed. The excited states are discussed and compared with shell-model calculations. The integrated experimental spectrum of primary gamma rays was compared with the statistical primary gamma ray spectrum. NSA

N70-39374 Princeton Univ., N.J.
CALCULATION OF KAON NUCLEON AND ANTIKAON NUCLEON SCATTERING LENGTHS AND PHASE SHIFTS BY A POLE DOMINANCE METHOD
Anthony Ichiro Sanda (Ph.D. Thesis) 1969 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-18185

Recently a procedure for representing a two-particle scattering amplitude as a sum of resonances in all three channels was derived by J. H. Schwarz. In addition to satisfying crossing symmetry, such a formula has a large domain of validity in the s, t, u plane. This method is applied here to kaon nucleon and antikaon nucleon scattering. The experimental parameters for the scattering, calculated in the low energy region, are: (1) S-wave scattering lengths for kaon nucleon isospin zero and one channels. (2) S sub 01, P sub 01, S sub 11, P sub 13, and D sub 13 phase shifts(2) for kaon nucleon isospin zero and one channels in energy region up to center-of-mass momentum 0.3 BeV/c. (3) The real part of the

s-wave scattering lengths for antikaon nucleon isospin zero and one channels. In addition, a sum rule relating the amplitudes for the kaon nucleon channel and antikaon nucleon channel is obtained. It is satisfied well for the real part of the amplitude and is not satisfied for the imaginary part. Dissert. Abstr.

N70-39379# European Organization for Nuclear Research, Geneva (Switzerland).
METHODS OF FORMATION OF THE SECONDARY PARTICLES IN THE INTERNAL TARGETS OF THE IHEP ACCELERATOR [METHODES DE FORMATION DES PARTICULES SECONDAIRES SUR LES CIBLES INTERNES DE L'ACCELERATEUR DE L'IFVE]
V. I. Gridasov et al 1969 13 p refs Transl. into FRENCH from Russian Rept. Presented at Conf. at Erevan, 1969
(CERN-Trans-70-2) Avail: AEC Depository Libraries

In order to extract particles in a given channel, a target is introduced at a certain time in the acceleration cycle at a point determined by the vacuum chamber. The channels of secondary particles of the IHEP accelerator present the peculiarity of working in a wide range of momenta. Several targets are provided for each channel. The formation of a beam of secondary particles of prolonged life, necessary for the counter method, is carried out with the help of slow targeting. A method of local orbit deformations is described for extending the possible interval for radial displacement of the beam. Also in order to excite orbit amplitude deformations the excitation of a supplementary field is described. NSA

N70-39387# Puerto Rico Nuclear Center, Mayaguez.
MEASUREMENT OF FLUORESCENT RADIATION IN VARIOUS SUBSTANCES INDUCED BY RADIOISOTOPE GAMMA RAY SOURCES
Eddie Ortiz and Katiuska Pagan de Ramirez de Arellano (M.S. Thesis—Puerto Rico Univ.) Jul. 1969 182 p refs
(Contract AT(40-1)-1833)
(PRNC-133) Avail: NTIS

The theory of X-ray fluorescence analyses is reviewed, and a non-dispersive X-ray fluorescence spectrometer consisting of a krypton or xenon proportional counter probe and electronic equipment with a multichannel analyzer is described. Radioisotope X-ray sources were prepared using Co-57 or Cd-109 for the excitation of samples including elements ranging from Z = 19 to Z = 56. The different photon energies available from a selection of radioisotopes provide a flexibility not available with an X-ray machine. Energy selection of neighboring characteristic X-rays is performed by X-ray filter techniques. Author (NSA)

N70-39425# Kernforschungszentrum, Karlsruhe (West Germany).
ALPHA DECAY OF HEAVY NUCLEI [ALPHA-ZERFALL UEBERSCHWERER KERNE]
Yu. A. Muzychika [1969] 14 p refs Transl. into GERMAN of RUSSIAN report JINR-P7-4435
(KFK-tr-309; JINR-P7-4435) Avail: AEC Depository Libraries

The energies of the alpha decay of super-heavy nuclei were estimated with the help of the Strutinsky method. The effect of single-particle potential parameters on the results of calculation of alpha decay energy was studied. The values of the alpha half life for super-heavy nuclei were obtained. Author (NSA)

N70-39428# Los Alamos Scientific Lab., N.Mex.
GAMMA RAY SPECTRA FOLLOWING THERMAL NEUTRON CAPTURE BY NEODYMIUM ISOTOPES
L. V. Groshev et al 29 Jan. 1970 13 p refs Transl. into ENGLISH of Akad. Nauk SSSR Rept. IAE-1489
(LA-4063-tr) Avail: NTIS

The gamma-ray spectra arising from thermal-neutron capture by samples enriched in the A = 142, 143, 144, 145, and 146 neodymium isotopes were measured with a germanium-dector spectrometer. The spectrum of the natural-isotope mixture was also obtained, both with the germanium detector and magnetic Compton spectrometers. The energies and intensities of the resolved gamma lines in the spectra were determined. From these data, gamma transition schemes for the five neodymium isotopes were set up. First data were obtained on the gamma transitions of odd-A neodymium isotopes after thermal-neutron capture; this information is interesting in that there are one (in Nd-143), three (in Nd-145), and five (in Nd-147) neutrons outside a closed neutron shell. In all the nuclei the relatively intense, high-energy transitions were found to go to the 0.6- to 0.8-MeV energy levels, which are more likely to be 3p 3/2 and 2f(+) 7/2 configurations than single-photon excitations with 3/2(−) spin-parity. A transition to the (2f 7/2) 3/2(−) Nd-145 level was not observed. Author (NSA)

N70-39439 Arizona Univ., Tucson.
QUARK SCATTERING IN RELATION TO THE BOOTSTRAP METHOD
John Henry Hunt (Ph.D. Thesis) 1969 193 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-19252

A reciprocal bootstrap is attempted between an assumed two-quark bound state and the pseudoscalar meson octet. The N/D method in the determinantal approximation is used to obtain two bootstrap equations in each channel. One equation in each channel comes from the requirement that D = 0 at the pole (bound-state) position. In each channel a once-subtracted dispersion relation for D is used. The requirement that the pole position not be affected by small changes in the choice of subtraction constants serves to determine a second bootstrap equation in each channel. The resulting set of six equations (two in each channel) depends on eight parameters, one of which is the quark mass m. By fixing two of the parameters from physical considerations, the equations may be solved to determine the others. Values of the quark mass m > or = to 10 to the 4th power GeV were required to satisfy those equations. This result is inconsistent with the approximations used in obtaining these equations. The assumed two-quark bound state cannot be bootstrapped by exchanging pseudoscalar mesons. Dissert. Abstr.

N70-39450# Technische Hochschule Hannover (West Germany).
ON THE ISOTOPIC SHIFT IN ISOTOPES Eu 151, Eu 152, Eu 153, Eu 154 AND THE NUCLEAR MOMENTS OF THE RADIOACTIVE ISOTOPES Eu 152 AND Eu 154 [UEBER DIE ISOTOPIEVERSCHIEBUNG DER ISOTOPE EU 151, EU 152, EU 153, EU 154 UND DIE KERNMOMENTE DER RADIOAKTIVEN ISOTOPE EU 152 UND EU 154]
Peter Heinecke (Ph.D. Thesis) Jan. 1970 46 p refs In GERMAN
Avail: NTIS

Isotopic shifts of the europium isotopes Eu-151, Eu-152, Eu-153, Eu-154, and the nuclear fission moment of Eu-152 were evaluated by Fabry-Perot spectrometer and digital data processing. Determination of the relative isotope position established a pronounced increase of the charged nucleus radius between neutron numbers 88 and 90 after imbedding of the 89th neutron in the europium nucleus 63Eu-151 with 88 neutrons. This increase is explained by the change in nucleus deformation between nuclei Eu-151 and Eu-152. Hyperfine structure measurements of the Eu-154 6865 A spectrum were analyzed and quadrupole moments for all europium isotopes with neutron numbers 88 to 91 were shown to be positive. Transl. by G.G.

N70-39459# Argonne National Lab., Ill.
PROCEEDINGS OF THE CONFERENCE ON PION-PION AND KAON-PION INTERACTIONS
Frank Loeffler and Ernest Malamud, eds. [1969] 776 p refs Conf. held at Argonne, Ill., 14–16 May 1969 Prepared jointly with Purdue Univ.
(CONF-690521) Avail: NTIS

Forty papers are presented under four main headings: (1)

pion-pion final states from strong interactions, (2) pion-pion system in electromagnetic and weak interactions, (3) kaon-pion and kaon-kaon final states, and (4) theory. E.C.

N70-39461# Virginia Univ., Charlottesville. Dept. of Physics.
HYPERFINE CONTACT INTERACTION IN THE IRON ATOM CALCULATED BY MANY-BODY THEORY
Hugh Kelly and Akiva Ron [1969] 21 p refs
(Contracts AT(40-1)-2915; F33615-69-C-1048)
(TID-25435) Avail: NTIS

The contribution of the hyperfine contact interaction in the iron atom has been calculated by many-body theory. Terms involving one and two Coulomb interactions are included, and the result for the contact constant is −4.55 Mc/sec, as compared with the experimental result of −5.1 Mc/sec, obtained by Childs and Goodman. Inclusion of an approximate relativistic correction changes the calculated value to −4.87 Mc/sec. An estimate of higher-order terms gives a theoretical result −5.35 Mc/sec, or −5.72 Mc/sec, when the relativistic correction factor is included. Author (NSA)

N70-39504# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
UNIVERSALITY OF THE TWO PION ISOVECTOR COUPLING
K. Fabricius and G. Kramer Apr. 1970 25 p refs
(DESY-70/18) Avail: AEC Depository Libraries

The Adler–Weisberger university is derived from a new gauge invariance of the S-matrix. Then, former attempts to prove the universality of pion-baryon scattering from the Adler self-consistency condition are discussed, and a counter example is given. The result is compared with the experimental data. Author (NSA)

N70-39506# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
EXPERIMENTS ON PARTICLE FIELD INTERACTIONS IN A SUPERCONDUCTING PROTON LINEAR ACCELERATOR [EXPERIMENTE UEBER TEILCHEN-FELD WECHSELWIRKUNGEN IN EINER SUPRALEITENDEN PROTONENLINEARBESCHLEUNIGERSTRUKTUR]
Karl Mittag Dec. 1969 70 p refs In GERMAN
(NP-18227) Avail: AEC Depository Libraries

Mechanisms of possible particle-field interactions are explained in detail. A theoretical description for the longitudinal and one for the transverse particle-field interactions are outlined. The experimental arrangement is described. Experiments on the determination of structure properties and on the excitation of acceleration modes and decay modes by the particle beam are described. The consequences of these experimental results on the structure of a superconducting proton linear accelerator are considered. Author (NSA)

N70-39519# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
VECTOR MESON PRODUCTION AND THE FACTORIZABILITY QUARK MODEL
A. P. Kobushkin 1970 11 p refs In RUSSIAN; ENGLISH summary Presented at the seminar of the Dept. of Elementary Particles in the Inst. for Theoret. Phys., Kiev
(ITF-70-23) Avail: AEC Depository Libraries

The processes O(−) + P yields 1(−) + 1/2(+) are investigated on the basis of the factorizability quark model at high energies. It is shown that the quark spin-flip amplitudes have to be taken into account in the reactions. The derived relations for differential cross sections are compared with experiment. Author (NSA)

N70-39528# Technische Hochschule Hannover (West Germany).
HYPERFINE STRUCTURE STUDIES BY SPHERICAL FABRY-PEROT INTERFEROMETER WITH INTERNAL ATOMIC ABSORPTION BEAM IN THE THULIUM AND EUROPIUM ISOTOPIC SPIN SPECTRA [HYPERFEINSTRUKTURUNTERSUCHUNGEN MIT EINEM SPHAERISCHEN FABRY-PEROT-INTERFEROMETER MIT INTERNEM ABSORPTIONS-ATOMSTRAHL IM TM 1 UND EU 1 SPEKTRUM]
Juergen Kuhl (Ph.D. Thesis) Feb. 1970 75 p refs In GERMAN
Avail: NTIS

A spherical Fabry-Perot interferometer, together with a photomultiplier, was used to determine hyperfine structural excitation levels in absorption spectra. Obtained were the A factors of five levels for the configurations 4f(13)6s6p and 4f(12)5d6s(2) in the thulium isotopic spin spectrum, and the A and B factors in the level 8p5/2 of the configuration 4f(7)6s6p in the europium isotope spectrum. Transl. by G.G.

N70-39539# Technische Hochschule Hannover (West Germany). Fakultaet fuer Mathematik und Naturwissenschaften.
INVESTIGATION OF HYPERFINE STRUCTURE OF THE 3d5(6S)4s4p z8P STATES IN THE MANGANESE ISOTOPIC SPIN SPECTRUM. THE QUADRUPOLE MOMENT OF Mn-55 NUCLEUS [UNTERSUCHUNG DER HYPERFEINSTRUKTUR DER 3d5(6S)4s4p z8P-TERME DES Mn I-SPECKTRUMS, DAS KERNQUADRUPOLMOMENT DES Mn-55]
Eberhard Handrich (Ph.D. Thesis) Nov. 1969 72 p refs In GERMAN
Avail: NTIS

The level crossing method is applied to excitation spectrum analysis on the 3d5(6S)4s4p states of the manganese-55 isotopic spectrum since the states of the z6P(J) multiplets in the described configuration possess a long enough life to provide enough resonance light for measurements. Hyperfine structural fission factors are determined from level crossing signals by diagonalizing the matrix of hyperfine structural exchange effects and by using the effective tensor operator. Obtained fission factors are evaluated and the radial parameters of individual electrons are found; radial parameter values express exchange reactions in electron shells and thus evolve the quadrupole moment of the Mn-55 nucleus. Transl. by G.G.

N70-39622# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukov (USSR). Inst. Fiziki Vysokikh Energii.
FORMATION OF ANTIDEUTERONS BY PROTONS WITH ENERGY UP 70 GeV
F. Binon, N. K. Vishnevski, and P. Duteil 1969 12 p refs In RUSSIAN
(IFVE-SEF-69-79) Avail: AEC Depository Libraries

The yield of antideuterons generated by protons with energy 43, 52, and 70 GeV on aluminum nuclei, was measured. A relative antideuteron yield increases with momentum decrease and with the increase of the emission angle. Author (NSA)

N70-39666# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SMALL DISTANCE BEHAVIOUR IN FIELD THEORY AND POWER COUNTING
K. Symanzik May 1970 34 p refs
(DESY-70/20) Avail: AEC Depository Libraries

For infinitesimal changes of vertex functions under infinitesimal variation of all renormalized parameters, linear combinations are found such that the net infinitesimal changes of all vertex functions are negligible relative to those functions themselves at large momenta in all orders of renormalized perturbation theory. The resulting linear first-order partial differential equations for the asymptotic forms of the vertex functions are, in quantum electrodynamics, solved in terms of one universal function of one variable and one function of one variable for each vertex function whereby, in contrast to the renormalization group treatment of this problem, the universal function is obtained from nonasymptotic considerations. A relation to the breaking of scale invariance in renormalizable theories is described. Author (NSA)

N70-39670# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
SOLUTION OF THREE-PARTICLE INTEGRAL EQUATIONS BY THE SEPARABLE EXPANSION METHOD
V. F. Kharchenko, N. M. Petrov, and V. E. Kuzmichev 1970 15 p refs In RUSSIAN
(ITF-70-22) Avail: AEC Depository Libraries

Use of a separable expansion for the two-particle t-matrix reduces the problem of three particles with pair interaction to a set of one-dimensional integral equations. By the subsequent separable representation of kernels of such integral equations (based on the Bateman method) the problem of three identical particles is reduced to the solution of a set of algebraic equations. Author (NSA)

N70-39671# Purdue Univ., Lafayette, Ind.
FINAL STATES WITH ONE OR TWO CHARGED PARTICLES AND A VISIBLE ANTIKAON(0) FROM KAON(−) DEUTERON INTERACTIONS AT 4.5 GeV/c
D. D. Carmony, R. L. Eisner, A. C. Ammann, A. F. Garfinkel, L. J. Gutay et al Feb. 1970 61 p refs
(COO-1428-166) Avail: NTIS

The antikaon(0) final states from the one and two prong plus vee topologies are discussed. Production of the $K^*(890)(-)$ resonance is analyzed from both K(−) proton and K(−) neutron interactions and is compared with absorption and Regge pole models. The production of Delta(1236)(−) is compared to the predictions of Thews and to those of Maor and Krammer. Strong $K^*(890)(-)$ production occurs in the given reaction and evidence for dominant vector meson exchange is given. The d^* enhancement is quite strong and K^*d^* production is discussed. Author (NSA)

N70-39678# Stanford Univ., Calif. High Energy Physics Lab.
MECHANICAL OSCILLATIONS INDUCED BY PENETRATING PARTICLES
B. L. Beron, S. P. Boughn, W. O. Hamilton, R. Hofstadter, and T. W. Martin Jun. 1970 9 p refs Presented at the Scintillation and Semicond. Conf., Washington, D.C., Mar. 1970
(Contract Nonr-225(67); Grant NSF GP-9498)
(AD-708000; HEPL-625) Avail: NTIS CSCL 20/8

Investigations into the production of mechanical oscillations in aluminum cylinders by high energy electrons reveal that the mechanism of excitation is a hot rod model in which the shower deposits heat in the bar and the hot zone expands causing mechanical vibrations. The conversion efficiency of this process is evaluated in these experiments. The hot rod mechanism does not present a significant background for gravitational events from cosmic rays in room temperature gravitational radiation detectors. Author (TAB)

N70-39679# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
ESTIMATE OF THE REGION OF INTERMEDIATE ENERGIES IN DISPERSION RULES FOR SUMS
I. G. Aznauryan and L. D. Solovev 1969 24 p refs In RUSSIAN
(IFVE-STF-69-43) Avail: AEC Depository Libraries

The method for the estimation of the contribution of the intermediate energy region into dispersion sum rules is considered. This method permits one to obtain parameters, describing processes at high energies from the low energy phase-analysis. The method is used to obtain the Regge residue functions of pion−nucleon scattering amplitudes B(+) (neutrino,triton) and B(−) (neutrino, triton). The rotation of polarization in pion (+ or −) proton high energy scattering in the framework of the Regge pole model is predicted. Author (NSA)

N70-39680# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
INDUCED RADIOACTIVITY AT THE PROTON SYNCHROTRON OF THE INSTITUTE OF HIGH ENERGY PHYSICS
V. T. Golovachik, G. I. Britvich and V. N. Lebedev 1969 17 p refs In RUSSIAN
(IFVE-ORE-69-76) Avail: AEC Depository Libraries

The results of experimental investigations of the induced radioactivity on the 70 GeV proton synchrotron are presented including induced radioactivity spectra, space−time distributions, and component composition of radiation. The beta radiation contributions are estimated. Author (NSA)

N70-39690# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki.
NONRELATIVISTIC CONNECTED STATES IN THE NUCLEON-ANTINUCLEON SYSTEM
O. D. Dalkarov, V. B. Mandeltsveig, and I. S. Shapiro 1969 20 p refs In RUSSIAN
(ITEF-749) Avail: AEC Depository Libraries

It is shown, that in the mass region 1580 to 1880 MeV there are many meson resonances with widths about 20 to 100 MeV. These resonances are quasinuclear bound states of a nucleon-antinucleon system with quantum numbers. Author (NSA)

N70-39701# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
ON PARASTATISTICS
K. Druel, R. Haag, and J. E. Roberts Apr. 1970 27 p refs
(DESY-70/15) Avail: AEC Depository Libraries

The physical content of a para-Fermi field theory is analyzed from the point of view of its local observables. The parafield theory leads to parastatistics only for special choices of the observable algebra, and only then gives a complete description of the relevant physical states. On the other hand there is always a physically equivalent description in terms of a certain number of ordinary Fermi fields from which the observables are selected by a (in general non-Abelian) gauge group. Thus one can always achieve a reduction to Fermi statistics by considering a system with different particle types which are distinguished by hidden (unobservable) quantum numbers. Author (NSA)

N70-39756# Saha Inst. of Nuclear Physics, Calcutta (India).
[SAHA INSTITUTE OF NUCLEAR PHYSICS] Annual Report, 1968
S. N. Bhattacharyya and R. Bhattacharyya, eds. Jan. 1969 187 p refs
(NP-18141) Avail: AEC Depository Libraries

A brief resume of the activities of the Saha Institute during the calendar year 1968 is presented. Research and development by the accelerator group, nuclear physics group, biophysics division, theoretical nuclear physics division, instrumentation division, Director's research group, and the technical physics group are summarized. An author index, list of publications in 1968, and the staff of the Institute are also listed. NSA

N70-39778# Lockheed Missiles and Space Co., Palo Alto, Calif.
HIGH-RESOLUTION GAMMA-RAY SPECTROSCOPY STUDY Semiannual Technical Report
W. L. Imhof 26 Jun. 1970 16 p
(Contract N00014-69-C-0372; ARPA Order 1404)
(A-708049; LMSC-695959) Avail: NTIS CSCL 18/8

In the laboratory program, runs have just been completed with the newly acquired Pu^{239} targets for bombardments with thermal neutrons and with neutrons of energies 0.050, 0.419, 5 and 15.4 MeV. For U235 additional gamma-ray spectra have been measured as a function of time for neutron bombardments at the following energies: thermal, 0.050, 0.419, 0.521, 0.618, 0.713, 0.810, 0.904 and 0.998 MeV. A preliminary analysis of the foregoing

data has been performed with the objective of finding gamma-ray lines which exhibit significant variations in production rate with neutron energy and/or target isotope. TAB

N70-39780# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
STUDY OF PROPERTIES OF MEDIUM-WEIGHT NUCLEI Final Report, 1 Nov. 1967–31 Mar. 1970
D. M. Van Patter 12 May 1970 24 p
(Grant AF-AFOSR-1431-68)
(AD-708166; AFOSR-70-1504TR) Avail: NTIS CSCL 20/8

The report includes a study of the gamma-ray decays of the first 3- octupole states of several nuclei in the A=40-70 region, and the observation of a large variation in their relative E1 transition strengths. Author (TAB)

N70-39783# Erlangen-Nuremberg Univ. (West Germany).
ELASTIC AND INELASTIC SCATTERING OF POLARIZED PROTONS IN B 11 IN THE ZONE OF THE GIANT RESONANCE [ELASTICHE UND INELASTICHE STREUUNG VON POLARISIERTEN PROTONEN AM B 11 IN BEREICH DER RIESENRESONANZ]
E. Salzborn and G. Clausnitzer [1970] 12 p in GERMAN Presented at Ger.-Neth. Conf. on Nucl. Phys., Bad Neuenahr, Germany
(Conf-680461-10) Avail: AEC Depository Libraries

Boron-11 was bombarded with polarized protons and the elastic scattering, the inelastic scattering on the first excited level of B-11, and the B-11(proton, alpha)Be-8 reaction in some selected energy regions were investigated. The results obtained are shown graphically: a typical spectrum, an excitation function for the differential cross section in elastic proton scattering, the inelastic scattering of protons, the coefficients of the Legendre polynomial up to a sub 5, and the results of a particle-hole calculation for C-12. NSA

N70-39796# Academy of Sciences (USSR), Moscow. Inst. of Physics.
MULTIPHOTON IONIZATION OF ATOMS
N. B. Delone and L. V. Keldysh 1970 38 p refs In RUSSIAN *Its* Preprint No. 11
(NP-18235) Avail: AEC Depository Libraries

The process leading to the ionization of atoms by an electromagnetic field, multiphoton ionization, is reviewed. In this case, ionization occurs as the result of the absorption of photons by atomic electrons; the energy of these photons is much lower than the ionization potential of the atom. The required high-intensity monochromatic radiation may be obtained only by the use of lasers. The process was observed in the case of the ionization of xenon atoms and hydrogen molecules by the radiation emitted by a ruby laser. The strong radiation field needed to observe the effect not only induces electron transitions from one stage to another but also changes these states. The probability of the multiphoton ionization of an atom depends on the type of polarization of the radiation and the ellipticity of the system. The theoretical explanation is based on the higher-order perturbation theory, or on the resonance excitation of an intermediate level. The experimental work requires either a high field voltage or a high specificity of the individual ionization related to the absorption processes. Author (NSA)

N70-39809# Tubingen Univ. (West Germany). Inst. fuer Theoretische Physik.
PHENOMENOLOGICAL LOCAL SOFT-CORE NUCLEON-NUCLEON POTENTIAL [EIN PHAENOMENOLOGISCHES LOKALES SOFT-CORE-NUKLEON-NUKLEON-POTENTIAL]
H. Eikemeier Feb. 1970 55 p refs In GERMAN; ENGLISH summary
(BMBW-FBK-70-5) Avail: AEC Depository Libraries

The parameters of a phenomenological local charge-independent soft-core nucleon-nucleon potential with central, spin-orbit, and tensor terms were fitted to the experimental data for the four two-nucleon states. The radial dependences are represented by sums of Gaussian functions. A potential of this kind is particularly suited for calculations in nuclear physics, because it can be handled easily. Especially it simplifies calculations in the harmonic oscillator shell model and in the refined cluster model. Author (NSA)

N70-39810# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
SEARCH OF PARITY MIXING IN Ta-181 BY MEASUREMENT OF THE CIRCULAR POLARISATION OF gamma RAYS
P. Bock and B. Jenschke Dec. 1969 8 p refs
(KFK-1116) Avail: AEC Depository Libraries

The circular polarization of the 482 keV gamma radiation of Ta-181 was measured. The result is P = −(6.0 + or − 2.5)0.000001. This number is corrected for instrumental asymmetries and bremsstrahlung. Author (NSA)

N70-39816# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
RHO PRODUCTION WITH LINEARLY POLARIZED PHOTONS
L. Criegee, G. Franke, G. Loeffler, K. P. Schueler, U. Timm et al May 1970 13 p refs
(DESY-70/19) Avail: AEC Depository Libraries

The process photon proton yields rho-meson(0) proton yields pion(+) pion(−) proton was studied with linearly polarized photons between 1.4 and 3.3 GeV. Almost pure diffraction like behavior is observed in the whole energy region. Author (NSA)

N70-39821# Institute of Nuclear Research, Krakow (Poland).
SOME INTERACTIONS OF NEGATIVE PION MESONS WITH NUCLEAR EMULSION AT 60 GeV/c [NIEKTOR KLASY ODDZIALYNAN MEZON MINUSOWEGO PIONU O PEDZIE 60 GEV/C ZJADRAMI EMU]
Krzysztof Rybicki 1969 106 p refs In POLISH
(INP-694) Avail: AEC Depository Libraries

Inelastic negative pion-proton interactions and coherent production of particles on emulsion nuclei by 60 GeV/c pions were studied. The results obtained were compared with the data on the interactions of accelerator pions of the momenta up to 25 GeV/c as well as with the results concerning the interactions of cosmic-ray pions at the average energy of about 200 GeV. The average multiplicity of 574 negative pion-proton events studied is 6.64 + or − 0.16. It was found that the majority of secondary particles are emitted into the forward hemisphere in the pion-proton cm system. As the multiplicity increases the angular distribution of secondaries becomes less asymmetric though it remains an anisotropic one. The number of the coherent-production events was estimated. NSA

N70-39822# Paris Univ., Orsay (France).
THE FLUID-SOLID PHASE-TRANSITION OF A HARD-SPHERE BOSE SYSTEM AT ZERO TEMPERATURE
Jean-Pierre Hansen, Dominique Levesque, and Daniel Schiff [1970] 11 p refs
(Rept-70/29) Avail: NTIS

The ground-state energy of a system of hard-sphere bosons of diameter sigma (Lennard-Jones 12-6 potential) is calculated by a variational method using a Jastrow wave-function for the fluid phase and a localized Jastrow × gaussian wave-function for the solid phase. Author

N70-39846# Stanford Univ., Calif. High Energy Physics Lab.
SCATTERING OF HIGH ENERGY ELECTRONS BY NITROGEN 14 AND 15

E. B. Dally, M. G. Croissiaux, and B. Schweitz (Inst. de Rech. Nucl.) Mar. 1970 33 p refs Submitted for publication Prepared in cooperation with Inst. de Rech. Nucl., Strasbourg
(Contract Nonr-225(67))
(AD-707999; HEPL-623) Avail: NTIS CSCL 20/8

Cross sections of elastic and inelastic electron scattering at incident electron energies of 250 and 400 MeV are presented. Data are given for elastic and inelastic scattering from N15 and elastic scattering from N14. The data are analyzed with the use of the shell model, in Born approximation. Author (TAB)

N70-39860 Boston Univ., Mass. Graduate School.
SIMULTANEOUS HYPERFINE AND ZEEMAN RESONANCES IN OPTICALLY PUMPED RUBIDIUM-85
Philip Bruce Newell (Ph.D. Thesis) 1969 187 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-18441

An atomic vapor of rubidium-85, optically pumped into the (3,3) sublevel of the ground-state hyperfine multiplet by irradiation with circularly-polarized D sub 1 resonance radiation is subjected simultaneously to a pulsed r.f. magnetic field and a continuous microwave frequency field. The composite nutations of the system under the influence of the two resonant fields were observed optically by monitoring the optical resonance radiation transmitted through the cell. The hyperfine nutation is observed to modulate the amplitude of the Zeeman nutation frequency at exact double magnetic resonance. The resonance splitting of the Zeeman resonance interaction and the energy level shifts associated with the triple quantum resonance are revealed and the resonance splitting due to the hyperfine resonance interaction is observed and measured. A theory is presented which describes the transient motion of the ensemble under the influence of the two resonant fields. Dissert. Abstr.

N70-39862# Panametrics Inc., Waltham, Mass.
DETERMINATION AND APPLICATION OF ABSOLUTE TRANSITION PROBABILITIES AND LIFE TIMES OF ATOMS, MOLECULES, AND IONS Final Scientific Report, 24 Jan. 1968 - 31 Mar. 1970
Stanley J. Wolnik, Robert O. Berthel, Myron R. Lewis, Lewis I. Rubin, and Edmund H. Carnevale 31 Mar. 1970 43 p refs
(Contract F19628-68-C-0235)
(AD-708184; AFCRL-70-0220) Avail: NTIS CSCL 7/4

The principle objectives and goals of the absolute f-value program are delineated in the light of their application to observational astrophysics. The scope of direct measurements is stated in relation to the f-value program. The significant accomplishments achieved in this work are listed and indicate that a considerable amount of knowledge or instrumental potential has been gained regarding f-values, lifetimes, and elemental abundances. Further values of CrI and new values for FeI were measured using the shock tube. Scientific papers detailing the work done are referenced and abstracted. Author (TAB)

N70-39879# Stanford Univ., Calif. Dept. of Computer Science
SYMBOLIC ANALYSIS OF FEYNMAN DIAGRAMS BY COMPUTER
J. A. Campbell (Tex. Univ., Austin) and Anthony C. Hearn Aug. 1969 79 p refs
(Contracts F44620-68-C-0075; ARPA SD-183)
(AD-708068; SU-AIM-91) Avail: NTIS CSCL 20/10

The paper describes a system of programs in the language LISP 1.5 which handles all stages of calculation from the specification of an elementary-particle process in terms of a Hamiltonian of interaction or Feynman diagrams to the derivation of an absolute square of the matrix element for the process. Examples of significant parts of the programs are presented in the text. Author (TAB)

N70-39883*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A PROBABILITY DENSITY FUNCTION FOR REFLECTED BEAM MOLECULES
W. H. Heybey 15 Sep. 1970 36 p refs
(NASA-TM-X-64555) Avail: NTIS CSCL 20/H

Nocilla proposed a theoretical model for the angular distribution of reflected molecules which yields adequate descriptions of observed distributions. An improvement of the model is obtained through the use of a more flexible probability density function whose definition issues from an argument on the scattering of the random speeds generated in the reflection process. The theoretical distribution derived from it was put to task with four experimental point groupings, two of which could not be reproduced satisfactorily by the older approach. The encouraging results prompted an extension of the work to include the determination of the aerodynamic force exerted by reflected molecules on an elemental surface. Author

N70-39906# Stanford Univ., Calif. High Energy Physics Lab.
TRANSITION DENSITY OF THE OCTOPOLE VIBRATION IN Pb 208 DETERMINED BY ELECTRON SCATTERING
J. H. Heisenberg and I. Sick Apr. 1970 18 p refs Submitted for publication
(Contract Nonr-225(67))
(AD-707998; HEPL-622) Avail: NTIS CSCL 20/8

Cross sections for the excitation by electrons of the 3- level at 2.61 MeV in 208Pb have been obtained between .5 1/F and 2.8 1/F momentum transfer. The data at small momentum transfer can be understood in terms of the modified Tassie-model. The data at high momentum transfer, however, indicate that the transition density has a detailed structure. A transition density which fits the data is presented and compared to theoretical predictions. Author (TAB)

N70-39943# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
SEARCH FOR NEW STABLE PARTICLES
B. Pontecorvo 1969 13 p refs
(JINR-D1-4638) Avail: AEC Depository Libraries

An electronic method is proposed to search for high energy radioactivity related to the existence of charged and neutral stable particles, which decay with a mean life of 10 to the minus 8 seconds. These particles are believed to be produced by modern accelerators. E.H.W.

N70-40038# Stanford Univ., Calif. High Energy Physics Lab.
EXPERIMENTAL OBSERVATION OF A "SPIN-SPIN EFFECT" IN THE NEUTRON TOTAL CROSS SECTION OF Co 59
D. C. Healey, J. S. McCarthy, D. Parks, and T. R. Fisher (Lockheed Res. Lab., Palo Alto, Calif.) Jun. 1970 14 p refs Submitted for publication
(Contract Nonr-225(67))
(AD-708003; HEPL-630) Avail: NTIS CSCL 20/8

Measurements of the spin-spin effect in the neutron total cross section of 59 Co employing a polarized 59 Co target are reported. Author (TAB)

N70-40048# Illinois Univ., Urbana.
OBSERVATION OF Xi HYPERON RESONANCES IN 5.5 Ge-V/c KAON(-) PROTON INTERACTIONS
P. F. Schultz [1969] 3 p refs Sponsored by AEC
(COO-1195-194) Avail: NTIS

Production was observed of the following previously observed Xi* hyperon resonances: Xi* hyperon (1530), Xi* hyperon (1930) and Xi* hyperon (1820). In addition a very narrow structure at a mass of 2295 + or - 15 MeV in the negative Xi hyperon positive pion negative pion mass combinations was observed; the statistical significance is 3 standard deviations above background. In the data, evidence for the negative Xi hyperon being a decay product of any Y* resonance (Y* yields Xi hyperon or Xi hyperon K pion) or any I = 3/2 Xi* hyperon resonance is not found. Author (NSA)

N70-40075# Stanford Univ., Calif. High Energy Physics Lab.
MEASUREMENTS OF NEUTRAL KAON SUB L AND NEUTRON TOTAL CROSS SECTIONS ON NUCLEI AT GeV ENERGIES
W. L. Lakin, E. B. Hughes, L. H. O'Neill, J. N. Otis and L. Madansky Mar. 1970 20 p refs Submitted for publication
(Contract Nonr-225(67); Grant NSF GP-9498)
(AD-708002; HEPL-827) Avail: NTIS CSCL 20/8

Measurements of neutral kaon sub L and neutron total cross sections are reported for C, Al, Cu, and Pb at average momenta of 9.0 GeV/c for neutral kaon sub L and 3.8 GeV/c for neutrons. Comparison is made with the predictions of an optical model calculation. Author (TAB)

N70-40081 Rice Univ., Houston, Tex.
QUANTUM HARD DISKS AND HARD SPHERES AT HIGH DENSITIES
Joseph Bumon Hubbard (Ph.D. Thesis) 1969 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19302

A high density asymptotic expression for the ground state energy per particle for a system of d-dimensional hard spheres at density p is given. Rigorous upper and lower bounds are established for hard spheres in f.c.c. or h.c.p. lattices. A cell cluster expansion is used to approximate the Helmholtz free energy for a hard sphere system at high density and low temperature, and the low temperature limit for disks in a triangular lattice is determined. Dissert. Abstr.

N70-40093# Notre Dame Univ., Ind. Dept. of Physics.
NUCLEAR STRUCTURE RESEARCH Annual Report, 1 Jan.–31 Dec. 1969
Jun. 1970 84 p refs
(Contract N00014-67-A-0242-0005; Grant NSF GP-10750)
(AD-707775) Avail: NTIS CSCL 20/7

The report is on the activities of the Notre Dame Nuclear Structure Laboratory for the year 1969. The main effort of the laboratory was on experimental work with the FN installation. The report discusses accelerator operation, equipment development, and description of experiments. TAB

N70-40184# Naval Research Lab., Washington, D.C.
THE FILTRATION OF PARTICLES OF ATOMIC DIMENSIONS Final Report
A. W. Saunders, Jr., R. L. Patterson, Jr., and L. B. Lockhart, Jr. 12 May 1970 25 p refs
(AD-707709; NRL-7047) Avail: NTIS CSCL 18/8

Particles of atomic dimensions, as typified by the primary decay products of radon, are readily removed from an air stream by passage through coarse fibrous filters or even through screens, while the radon parent is unaffected. The inverse relationship between the efficiency of removal and the air velocity indicates that diffusion is the mechanism primarily responsible for deposition of these small particles. However, if the particles become attached to aerosols, their collection is governed by aerosol behaviors where collection depends both on filter characteristics and air velocity. These particles are readily collected on aerosol particles and provide a radioactive tag by which aerosol or filter behavior may be studied. Such measurements can be extended to size ranges and concentration levels below those convenient for other techniques. Author (TAB)

N70-40237# Oregon State Univ., Corvallis. Radiation Center.
MODAL METHODS FOR COMPUTING FAST REACTOR SPECTRA Annual Progress Report
Alan H. Robinson 15 Nov. 1969 14 p
(Contract AT(45-1)-2058)
(RLO-2058-1) Avail: NTIS

A modal method of representing neutron spectra in fast reactors is presented for two dimensional diffusion theory calculations. The method is applied to a 1000 MW(e) fast reactor design and the EBR-2 core. NSA

N70-40265# Bettis Atomic Power Lab., Pittsburgh, Pa.
CALCULATION OF NEUTRON SLOWING DOWN PROPERTIES IN THORIUM-WATER LATTICES
R. E. Swaja Mar. 1970 12 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-T-2346; CONF-700608-2) Avail: NTIS

As a test of the reliability of nuclear data used to analyze thorium bearing reactors, a comparison was made between calculated and experimentally determined neutron slowing down properties as measured in ThO2–H2O–D2O lattices. The two principle quantities of interest are the age of the fission neutrons and the variation of net saturated activation with source-detector separation. Author (NSA)

N70-40268# Central Research Inst. for Physics, Budapest (Hungary).
METHOD FOR DETERMINATION OF NEUTRAL DECAY POINTS WITHOUT TRACK RECONSTRUCTION IN SPACE
E. Nagy, F. Telbisz, and G. Vesztergombi 31 Mar. 1970 5 p Presented at the session of the Bubble Chamber Comm. of JINR, Budapest, 1969
(KFKI-70-8-HEP) Avail: AEC Depository Libraries

A FORTRAN program computer for estimating a physical parameter from bubble chamber particle tracks using immediately the coordinates measured on three stereoviews (without track reconstruction) is briefly described. The program consists of two parts which are the geometrical preparation program and the decay point fitting program. This program is being used to find the best coordinates of the decay point of the neutral kaon → 2 neutral pions decay. NSA

N70-40274# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
ANALYTIC HARD PION METHODS: THE A1 RHO MESON PION SYSTEM
J. J. Brehm and E. Golowich [1969] 46 p refs Sponsored in part by NSF
Avail: NTIS

Current algebra and analyticity are used to study vertex functions in the A1 pho-meson pion system. Employing the CVC and PCAC relations and the SU(2) × SU(2) current algebra, Ward identities are generated relating two and three point functions of vector and axial vector currents. The pion poles are extracted from the vertex functions and their isospin content is shown. Form factors readily studied are defined, and a relation involving the pion form factor is deduced from the Ward identities. This relation is used with suitable low energy approximations to calculate an effective range formula for the pion form factor, and consequently from unitarity, the p-wave pion pion phase shift. Using A1-dominance, analytic effective-range formulas are obtained for the form factors in the vector current matrix element of pion, A1 mesons. From these form factors, measurable in the positron electron yields pion A1 reaction, the A1 yields rho-meson pion width and the A1 pho-meson spin correlation are calculated. The methods are extended to encompass both pion pion and pion A1 cut contributions, and a set of coupled integral equations are derived which give approximately their form factors. Author

N70-40275# Rockefeller Univ., New York.
FIELD-CURRENT IDENTITIES AND NUCLEON RADII
M. A. B. Beg, J. Bernstein (Stevens Inst. of Tech.), and M. Tausner (Stevens Inst. of Tech.) [1969] 18 p refs Prepared in cooperation with Stevens Inst. of Tech.
(Grant NSF GP-8877)
Avail: NTIS

The results are presented of a calculation of the electromagnetic radii of nucleons predicated on the assumption of vector dominance for the hadronic electromagnetic current. Vector dominance is implemented through the use of field current identities. An attempt is made, for the isovector radii, to take account of the structure of the rho-meson nucleon vertex. While the numerical results are somewhat model dependent, they do lend support to the view that the radii are determined by the low energy dynamics of the meson-nucleon system. Author

N70-40304# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
PHYSICS VERIFICATION PROGRAM PART 3: TASKS 2 AND 3 Final Report
M. N. Baldwin, G. T. Fairburn, R. C. Mason, W. G. Pettus, and M. E. Stern Apr. 1970 178 p refs
(Contract AT(30-1)-3647)
(BAW-3647-16) Avail: NTIS

The Physics Verification Program objectives were: (1) To generate detailed experimental power-profile data suitable for verifying the accuracy of three-dimensional computer codes; and (2) to correlate power profile data with the signals generated by an all-solid incore detector string. Measurements on plutonium lattices were performed to verify the proposed procedures by measurements on a conventional UO2 lattice, and to obtain measurements of parameters for several plutonium-bearing lattices. All of the experimental results obtained are summarized. Author (NSA)

N70-40319*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TECHNIQUES FOR GAMMA RAYS
Carl E. Fichtel Sep. 1970 45 p refs Presented at IAU Symp. No. 41, New Tech. in Space Astronomy, Munich, 10-14 Aug. 1970
(NASA-TM-X-65335; X-662-70-346) Avail: NTIS CSCL 20H

A state-of-the art review is presented of instruments to detect high energy photons arriving from space. A wide variety of detectors, flown on high altitude balloons and small satellite experiments, are discussed and descriptions are given for those which will be flown in the future or at least are being proposed. Emphasis is placed on four distinctly different types of spark chambers being considered; the conventional optical spark chamber, the vidicon system, the sonic chamber, and the multiwire digitized spark chamber. D.L.G.

N70-40361# Northeastern Univ., Boston, Mass. Dept. of Physics.
POSSIBLE PRESENCE OF A SCALAR DIPION RESONANCE IN rho-MESON PHOTOPRODUCTION EXPERIMENTS
Gary K. Greenhut Aug. 1970 19 p refs
(GRANT NSF GP-9217)
(NUB-2024) Avail: Issuing Activity

The scalar resonance sigma-meson (740) may be present in pion pair production experiments at nonforward angles in the region of the rho-meson. The consequences of this resonance in the cross section are examined in terms of the t-dependence of the mass surpression factor in the rho-meson shape, and the possibility of observing rho-meson, sigma-meson interference in the antisymmetric part of the cross section. Author

N70-40382# Michigan Univ., Ann Arbor.
PROPERTIES OF PROTON-PROTON INTERACTIONS BETWEEN 70 GeV AND 600 GeV
L. W. Jones, A. E. Bussian, G. D. De Meester, D. E. Lyon, B. W. Loo et al. [1970] 45 p refs Submitted for publication
Supported by NSF Prepared jointly by Mich. Univ., Ann Arbor, Wis. Univ., Madison, Colo. State Univ., Argonne Natl. Lab., Ill., and Calif. State Coll., Los Angeles Avail: Issuing Activity

A cosmic ray experiment at Echo Lake, Colorado, employing a 2000 liter liquid hydrogen target together with spark chambers and an ionization calorimeter, was used to study the interactions of protons with protons at energies above 70 GeV. Analyzed data give quantitative results on the energy dependence of average charged-particle multiplicity, on the distributions of prong multiplicities and angles, and on the difference between reactions in hydrogen and in heavier target nuclei. The neutron-charged hadron flux ratio was studied, and detailed characteristics of the ionization calorimeter were systematically analyzed. Direct measurements of the nucleon-nucleon total inelastic cross section are reported. Author

N70-40373# Northeastern Univ., Boston, Mass. Dept. of Physics.
PHOTOPRODUCTION OF MUON PAIRS WITH INVARIANT MASSES BETWEEN 930 AND 1770 MeV
D. R. Earles, W. L. Faissler, M. Gettner, G. Lutz, K. M. Moy et al. Aug. 1970 13 p refs
(GRANT NSF GP-9217)
(NUB-2025) Avail: Issuing Activity

An experiment on photoproduction of muon pairs with invariant masses between 930 and 1770 MeV is reported. The measured invariant mass spectrum is in good agreement with theoretical QED predictions. A QED cut-off Lambda > or = to 1.9 BeV (2 s.d.) and a branching ratio equal to 0.000217 + or - 0.00006 are obtained. For masses above the Phi limits which are approximately 100 times smaller than the rho are placed on resonance production. Author

N70-40375# Puerto Rico Nuclear Center, Mayaguez.
NEUTRON DIFFRACTION PROGRAM Progress Summary Report
M. I. Kay and R. Kleinberg Apr. 1970 18 p refs
(Contract AT(40-1)-1833)
(PRNC-137; PSR-8) Avail: NTIS

Research reported includes the following: (1) A study was conducted on the magnetic structure of vivianite Fe3(PO4)2-8H2O. Neutron diffraction data indicated that the magnetic structure consists of ferromagnetic planes, with an antiferromagnetic coupling between planes, to give a magnetic cell that is twice the size of the chemical unit cell. (2) The room temperature crystal structure of paraelectric NaH3(SeO3)2 was refined by the full-matrix least-squares method using 353 three-dimensional neutron intensity data. (3) A relationship was determined between incoherent neutron scattering and nuclear magnetic resonance. The relationship was then used to compare neutron scattering and NMR in water. D.L.G.

N70-40397# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki.
CONCERNING THE EFFECTIVENESS OF MULTITURN INJECTION
V. K. Plotnikov 1969 24 p refs In RUSSIAN
(ITEF-739) Avail: AEC Depository Libraries

Multiturn particle injection into the ring accelerator by filling the phase volume of transversal motion is considered. The effective injection for the method of different frequencies and the resonance method is calculated. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N70-39018# Nagoya Univ. (Japan). Inst. of Plasma Physics.
EFFECTS OF A HIGH-FREQUENCY ELECTRIC FIELD ON MICRO-INSTABILITIES DRIVEN BY DENSITY GRADIENT
Masao Okamoto, Tsuneo Amano, and Kazuo Kitao Jun. 1970

33 p refs Submitted for publication
(IPPJ-92) Avail: NTIS

Drift, drift-dissipative, and drift-cyclotron instabilities in an inhomogeneous plasma are considered for the case when a uniform high frequency electric field is applied along the magnetic field. For the applied field, the dipole approximation is made and the skin effect is neglected. Without averaging the distribution function over the period of the applied electric field, the dispersion relations are derived for both the collisionless and collisional regimes. It is found that the high frequency field whose frequency is, within some ranges, increasing the frequencies of perturbations, can stabilize drift instabilities and also drift-cyclotron instabilities with finite k sub z of the fluid-type, where k sub z is the component of the wave vector along the magnetic field. It is found, however, that when the unstable drift-dissipative mode is stabilized the stable mode becomes unstable. Author

N70-39037 Princeton Univ., N.J.
INVESTIGATIONS OF A SHEET MODEL FOR A BOUNDED PLASMA WITH MAGNETIC FIELD AND RADIATION
Allan Bruce Langdon (Ph.D. Thesis) 1969 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-18171

A number of extensions are made to the usual one-dimensional sheet model for a plasma. The sheets, which lie in the y-z plane, are allowed to move in the x-y directions, passing freely through one another. Physical properties of this model are discussed. Expressions are derived for the synchrotron radiation from a gyrating sheet and the thermal radiation on the discrete space-time grid (used in the computer code). Dispersion properties of electromagnetic waves in the hot magnetized slab are discussed. Some peculiar aspects of the retarded radiation fields in one dimension are reconciled with the retarded fields from an extended body in three dimensions. The coupling of oscillations of the bounded slab to the field outside is discussed. A computer code has been written to follow the model in time from some initial state. Measurements are presented and discussed of sheet drag and of the spectrum of emitted radiation when the model is near equilibrium. Dissert. Abstr.

N70-39177# Institute of Nuclear Research, Warsaw (Poland).
PLASMA FURNACE WITH LAMINAR PLASMA GENERATOR [PIEC PLAZMOWY Z LAMINARNYM GENERATOREM PLAZMY]
W. Brzozowski and M. Mikos 1970 30 p In POLISH; ENGLISH summary
(INR-1171) Avail: AEC Depository Libraries

A description of the application of arc plasma furnaces for melting of various materials is given. The construction of the arc plasma furnace is described. Results of operating conditions of the arc plasma torch being a thermal source are cited. Some results obtained at the first series of melts, as well as some operating characteristics of the plasma torch and plasma furnace are given. Author (NSA)

N70-39199# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
EXPERIMENTAL WORK DONE ON THE TOKAMAK PROGRAM AT KURCHATOV INSTITUTE FROM 1960 TO 1968
P. Ginot Sep. 1969 55 p refs
(NP-18237) Avail: AEC Depository Libraries

The experimental effort in the Tokamak program is described. Memos summarize the main publications. Tables, deduced from the memos, present the work done on each subject, by each author, and on each machine. The text comments on the phases of the progression of the research and the approach used. Author (NSA)

N70-39342# Academy of Sciences (USSR), Moscow. Inst. Fiziki.
INTERACTION OF RELATIVISTIC ELECTRON BEAMS WITH THE PLASMA AND THE PROBLEM OF CRITICAL CURRENTS
L. S. Bogdankevich 1970 66 p refs In RUSSIAN
(NP-18233) Avail: AEC Depository Libraries

The behavior of an electron beam within an equipotential drift space along the axis of a metallic waveguide was examined. The critical currents that may pass through such a system may be determined on the basis of the stability conditions of the electron beam, or its passage through the compensation ionic background or through the more dense portions of the plasma. The investigation involved an examination of the boundary currents in noncompensated electron beams, critical currents in compensated, unlimited beams, the effect of the longitudinal dimensions of the system on the critical currents in the electron beams, the interaction of relativistic electrons with the plasma, the stability of the beams in the plasma, and critical currents of relativistic electron beams in the plasma. It was concluded that when the electron beam current is lower than both the critical current of the compensated beam and the boundary current of the noncompensated beam, no instability is generated in the system at the neutralized stage. NSA

N70-39429# Academy of Sciences (USSR), Moscow. Inst. of Physics.
ONE OF THE RULES FOR PLASMA DIFFUSION IN STELLARATORS
I. S. Shpigel 1970 15 p refs In RUSSIAN
(NP-18257) Avail: AEC Depository Libraries

Plasma confinement in stellarators was analyzed within the concepts of plasma diffusion in toroidal systems. Calculations of various cases of plasma diffusion confirmed the experimental data on linear dependence of normalization of plasma confinement time on the magnitude of the angle of transformation of the magnetic field lines. The theory of the diffusion of weak collisional plasma in toroidal axially-asymmetric stellarator systems is still very new and was used in this work only for determining the diffusion coefficients as functions of the characteristics of confining field and plasma parameters. NSA

N70-39432# Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik.
THE LAMINAR ELECTRODE BOUNDARY LAYER OF A LINEAR MAGNETOGASDYNAMIC CHANNEL FLOW OF PARTIALLY IONIZED FOUR-COMPONENT PLASMA WITH HIGH-ELECTRON TEMPERATURE [DIE LAMINARE ELEKTRODENGRENZSCHICHT EINER LINEAREN MAGNETOGASDYNAMISCHEN KANALSTROEMUNG EINES PARTIELL IONISIERTEN VIERKOMPONENTENPLASMAS MIT ERHOEHTER ELEKTRONENTEMPERATUR]
H. A. Claassen Nov. 1969 78 p refs In GERMAN
(JUL-624-TP) Avail: AEC Depository Libraries

The problem of a magnetogasdynamic boundary layer is treated under the special aspect of a partially ionized anisotropic plasma with high electron temperature, which was fed from a hot electrode with the electrons necessary for current transport. The special forms of the boundary-layer equations are derived by use of the transport equations and are provided with a supplementary boundary condition for the electron temperature resulting from the theory of the collision-free Langmuir layer. The boundary-layer equations are transformed with respect to the possibility of local similar solutions. The transformation used limits the large number of possible nuclear currents to the special case of an isothermal electromagnetic accelerated plasma flow. The results of a numerical solution of the transformed boundary-layer equations are discussed and the limits of the theory are indicated. Author (NSA)

N70-39624# Academy of Sciences (USSR), Moscow. Physics Inst.
THEORY OF PLASMA TURBULENCE FOR STRONG

WAVE-PARTICLE INTERACTION
L. E. Rudakov and V. N. Tsytovich 1970 28 p refs *Its* Preprint No. 28
(NP-18256) Avail: AEC Depository Libraries

A perturbation theory is developed, in the first approximation of which the strong interaction between waves and particles is considered near the resonance omega = kv. There follows a useful prescription for the calculation of the nonlinear interaction. It is shown in what limit the usual approximations of perturbation theory may be applied. The effects of strong wave-particle interaction reduce the nonlinear interactions, e.g., in the case of ion-acoustic turbulence the nonlinear interaction with electrons is shown to be always small compared to the quasi-linear one, and for the case of Langmuir turbulence the effects of strong interaction become important in the nonlinear interaction if the noise level, w, is sufficiently high i.e., w is greater than or approximately eta T kr sub D, where eta is the density, T the temperature, k the characteristic wave number and *r* sub D the Debye length. Author (NSA)

N70-39682# Physics International Co., San Leandro, Calif.
DYNAMIC EFFECTS OF HIGH NU/GAMMA BEAM PLASMA INTERACTIONS Final Report, Feb. 1968–Aug. 1969
Gerold Yonas, Philip W. Spence, Bruce M. Ecker, and John S. Rander Aug. 1969 105 p refs
(Contract DASA01-68-C-0096)
(AD-708032; PIFR-106-2; DASA-2426) Avail: NTIS CSCL 20/9

Generation and propagation characteristics of high nu/gamma electron streams have been investigated using diode voltage and current diagnostics, net and primary beam current monitors, graphite calorimeters and thin foil depth dosimeters, and scintillator-photodiode detectors. The effects of beam-plasma interactions of the time and spatial dependence of beam current have been measured and correlated with a diffusion dominated model of current neutralization. Important parameters in the model are primary current risetime, avalanche breakdown time of the background gas, and the plasma conductivity after breakdown. The existence of large primary electron transverse energy components was consistent with a magnetic pressure balance calculation indicating a dependence on (nu/gamma) sub net and the degree of current neutralization. Beam energy loss mechanisms are discussed and compared with observed beam energy loss. Author (TAB)

N70-39674# California Univ., Livermore. Lawrence Radiation Lab.
PLASMA HEATING IN THE SUPERCONDUCTING LEVITRON BY ENERGETIC ELECTRONS
O. A. Anderson and C. W. Hartman 1 Apr. 1970 10 p refs
(UCRL-50824) Avail: NTIS

Experiments with axisymmetric toroidal devices such as Levitrons or Tokamaks have yielded dense plasmas with confinement times exceeding Bohm time by two orders of magnitude. Furthermore, nearly classical energy confinement has been demonstrated in Tokamaks. If this situation is maintained at higher temperatures, then self-sustaining thermonuclear reactions seem feasible. Thus, a convenient method for heating dense plasma to the ignition temperature is needed. It is shown that in an axisymmetric torus, energetic electrons, heated in situ by microwaves before introduction of the dense plasma, can provide such heating. Assuming classical energy confinement, it is found that ignition temperature can be reached in a device of moderate size and field strength, comparable with the existing superconducting Levitron. Plasma density is not limited by microwave cutoff. The ring current required depends on the field shape needed to confine the energetic electrons, but may be as low as 500 kA. Author (NSA)

N70-39683# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
PERIODIC PULLING OF THE DRIFT INSTABILITY IN A THERMAL PLASMA
R. H. Abrams, Jr. Jan. 1970 116 p refs
(Contract AT(40-1)-3405; Grant AF-AFOSR-1016-68)
(CRO-3405-30; BN-642) Avail: NTIS

An analysis is presented of the perturbed van der Pol equation. The dispersion relation for the plasma drift wave is derived. The experimental apparatus, procedure, and results are described. NSA

N70-39683# Oak Ridge National Lab., Tenn.
REPORT OF INTERIM DATA SYSTEM
J. E. Francis and N. H. Lazar Jun. 1970 51 p refs
(Contract W-7405-eng-26)
(ORNL-4425) Avail: NTIS

The facility is being used to study plasmas consisting of a dense energetic electron distribution produced by electron-cyclotron resonant heating in a combination mirror-quadrupole confining magnetic field. Diagnostic tools used are the study of the bremsstrahlung spectrum resulting from electron-atom and electron-ion scattering, the diamagnetic flux change resulting from turning the plasma on and off, and the ionization current produced by the energetic electrons remaining during the plasma afterglow. A LINC-8 computer was adapted to serve as a data acquisition system to assist in on-line analyses of bremsstrahlung spectra and to record machine parameters such as ambient pressure, magnetic field conditions, and applied heating power. A discussion of the bremsstrahlung calculation and the program listing is given. Author (NSA)

N70-39692# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES Annual Progress Report
1 Jun. 1970 24 p
(Contract AT(40-1)-3405)
(ORO-3405-29; APR-5) Avail: NTIS

Experimental research progress on drift instabilities in Q machines is reported. The material is divided into three sections: (1) wave-instability physics and plasma stabilization, (2) Q-machine technology, and (3) general experimental methods and technological spin-off possibilities. NSA

N70-39697# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATIONS OF LOW-FREQUENCY OSCILLATIONS IN A THERMAL PLASMA
E. J. Yadlowsky Jan. 1970 95 p refs
(Contract AT(40-1)-3405)
(ORO-3405-31; BN-641) Avail: NTIS

Dispersion relations for the lf oscillations that are expected in a Q machine are derived. Particular emphasis is given to ion–acoustic waves. An experimental analysis of the current-excited oscillations in a thermal plasma is described. Other studies discussed are: (1) nonlinear interactions between ion waves and draft waves, (2) standing ion–acoustic waves in a bounded moving plasma, and (3) parametric excitation of ion–acoustic waves. NSA

N70-39702# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
CONTROLLED FUSION AND PLASMA RESEARCH: A LITERATURE SEARCH
Milton O. Whitson, comp. Jan. 1970 493 p refs
(TID-3557(1969-Suppl)) Avail: NTIS

This search includes 2849 references on various aspects of plasma physics and controlled thermonuclear research. Report number, author, corporate author, and subject indexes are included. Author (NSA)

N70-39739# Illinois Univ., Urbana. Coordinated Science Lab.
THE MIXED BOUNDARY-INITIAL VALUE PROBLEM FOR VLASOV EQUATION
Kenneth Evans, Jr. Jun. 1970 22 p refs

(Contract DAAB07-67-C-0199)
(AD-707676; R-473; UILU-eng-70-218) Avail: NTIS CSCL 20/9

The mixed boundary initial value problem for the Vlasov equation is treated by double Laplace transformation. It is found that certain relations must be satisfied by the boundary and initial values in order to have a well-defined problem. The case of a cold beam in a cold plasma is treated as a simple example. An approach to the problem via discrete velocities is treated in an appendix. Author (TAB)

N70-39827# Akademiya Nauk URSR, Kharkov. Fiziko-Teknicheskii Inst.
BEHAVIOR OF OHMIC-HEATED PLASMA IN A LARGE LATITUDE STELLARATOR URAGAN
V. N. Vishnevetskii, E. D. Volkov, and A. G. Dikii 1969 20 p refs In RUSSIAN
(KHFTI-69-48) Avail: CFSTI

The experiments were carried out under ohmic heating conditions, with a density of helium plasma n sub e = (2 to 8) x 10 to the 12th power cm to the −3rd power. The following parameters were measured: the voltage at the stellarator circumference, the discharge current, the electron density, and the electron temperature. The main object of the experiments was to throw light on the effect of the shear and the rotational transform on the behavior of the plasma. NSA

N70-39845# Avco Corp., Lowell, Mass. Applied Technology Div.
RADIATION STUDIES OF ARC HEATED PLASMAS Final Technical Report, 15 Sep. 1967 – 30 Sep. 1969
J. C. Morris and R. U. Morris Wright-Patterson AFB, Ohio ARL Jan. 1970 100 p refs
(Contract F33615-68-C-1081)
(AD-708161; AVATD-0207-69-CR; ARL-70-0038) Avail: NTIS CSCL 20/9

The following final report presents the results of an experimental and analytical program to determine the radiative properties of high temperature high density plasmas. The plasmas studied in this work were produced in a mechanically constricted arc generator. Author (TAB)

N70-39904# European Atomic Energy Community, Brussels (Belgium).
INSTANTANEOUS POPULATION DENSITIES OF THE EXCITED LEVELS OF HYDROGEN ATOMS, HYDROGEN-LIKE IONS, AND HELIUM ATOMS IN OPTICALLY THIN AND THICK NON-LTE PLASMAS
H. W. Drawin and F. Emard Feb. 1970 233 p refs Prepared in cooperation with Comm. a l'Energie Atomique, Fontenay-aux-Roses, France
(EUR-CEA-FC-534) Avail: AEC Depository Libraries

The instantaneous population densities were calculated for the levels of atomic hydrogen, hydrogen-like ions, and atomic helium on the basis of the collisional−radiative model. The calculations were performed for the optically thin case as well as for four different degrees of radiative absorption characterized by the gross radiative reduction coefficients. The results are listed in tables containing two dimensionless coefficients, from which the absolute values of the instantaneous population densities can be calculated if the actual number density of the ground state particles is known. For a completely homogeneous, steady-state plasma these population densities were calculated. The results are listed in separate tables. It was assumed that the particles have a Maxwellian distribution. However, the results can also be used for determining the population densities in plasmas containing two distinct groups of electrons of very different density and temperature. NSA

N70-39989# Northeastern Univ., Boston, Mass. Dept. of Electrical Engineering.
THEORETICAL STUDIES OF IONOSPHERIC WAVE MOTION Final Report, 1 Jul. 1966 – 31 Dec. 1969
Harold R. Raemer, John C. Field, and Yash Pal Verma 31 Dec. 1969 453 p refs
(Contract AF 19(628)-5845)
(AD-708181; AFCRL-70-0001) Avail: NTIS CSCL 20/14

Work reported concerns theoretical study of wave propagation in a vertically inhomogeneous medium consisting of electron-ion plasma and neutral gas, with special reference to the ionosphere. General system equations developed on a previous project are used as a basis for this work. The work consists of four separate but related studies of various aspects of wave propagation in this type of medium. Section I is a summary of the project work. Remaining sections are reports on individual studies. Section 2 reports a study of wave propagation in a compressible, inhomogeneous, lossy electron plasma. Coupling between electroacoustic and electromagnetic waves is studied through WKB methods with numerical results showing the variation of coupling effects as frequency is varied. Section 3 is a study of approaches to simplification of the equation system through physical arguments to jestify neglect of certain effects. Section 4 is an analytical-numerical approach to solution of the general equations. The state-transition matrix for the general system is found and illustrative numerical results for certain ionospheric parameter regimes are shown. Section 5 deals with use of the method of characteristics to solve problems of wave propagation in a plasma medium. Author (TAB)

N70-39990# Aeronutronic, Newport Beach, Calif.
AN INVESTIGATION OF THE HIGH PRESSURE ELECTRODELESS ARC IN AIR 2 Technical Report, Jan. – Dec. 1969
Donald D. Hollister Wright-Patterson AFB, Ohio AFFDL Apr. 1970 44 p refs
(Contract F33615-69-C-1273)
(AD-708173; U-9770; AFFDL-TR-70-14) Avail: NTIS CSCL 20/9

The Elenbaas-Heller energy equation is enhanced by a radiation term and combined with the electromagnetic equations to form a set which is descriptive of the high frequency induced discharge and amenable to numerical integration. An existence condition, which is theoretically derived from considerations of the minumum entropy state of the discharge, is found necessary to un-mix boundary conditions and enable finding the unique solution for stated conditions of discharge pressure, and magnitude and frequency of the induction field. This solution is found by an iterative process. The fundamental importance of radiative transport is discussed in connection with the existence condition and with the choice of the radiation model employed in this study, and an appraisal is given of the limits of the present theory. Author (TAB)

N70-40068# Minnesota Univ., Minneapolis. Heat Transfer Lab.
STUDY OF A TRANSPIRATION-COOLED, CONSTRICTED ARC Final Technical Report, Jul. 1967 – Jun. 1969
J. Haberlein, E. Pfender, and E. R. G. Eckert Jan. 1970 136 p refs
(Contract F33615-67-C-1353)
(AD-707856; HTL-89; ARL-70-0007) Avail: NTIS CSCL 20/9

The report covers theoretical and experimental studies of a constricted, transpiration-cooled arc using argon or nitrogen at atmospheric pressure as coolant. Most of the experiments are conducted with argon as coolant in a current range from 40 to 200 Amps. Arc performance characteristics are shown obtained from solutions of the conservation equations with a number of simplifying assumptions. The sensitivity of these characteristics on uncertainties of thermodynamic and transport properties is demonstrated and, for cooling with nitrogen, the influence of various boundary conditions on the arc characteristics is also shown. Author (TAB)

N70-40232# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SUPERSONIC EXPANSION FLOW OF AN IONIZED GAS Scientific Interim Report
O. Igra Mar. 1970 105 p refs

(Grant AF-AFOSR-1368-68)
(AD-708126; UTIAS-30; AFOSR-70-0765TR) Avail: NTIS CSCL 20/9

In a supersonic expansion of an ionized gas, the dominant factor in describing the atomic processes is generally the recombination rate constant K sub R. Several models describing the recombination process have been reviewed in some detail. It was found that, depending on the adopted definition, different models will yield different values of K sub R for the same electron temperature and number density. A comparison between experimental and theoretical values of K sub R becomes even more complex since in the majority of the experiments K sub R is determined from the measured rate of disappearance of free electrons. These measurements give the correct decay coefficient, but only in certain circumstances will it reduce to the correct value of K sub R. Author (TAB)

N70-40266# California Univ., Los Angeles. School of Engineering and Applied Science.
PLASMA CONFINEMENT BY LOCALIZED FEEDBACK CONTROLS
P. K. C. Wang 1 Jun. 1970 11 p refs Presented at the Symp. on Feedback and Dyn. Control of Plasmas, Princeton, N.J. 18-19 Jun. 1970
(Grant AF-AFOSR-1547-68)
(AD-708180; AFOSR-70-1759TR) Avail: NTIS CSCL 20/9

The problem of confining a plasma in a specified bounded spatial domain by means of feedback control forces applied over an outer shell of the domain is considered. Using a two-component fluid model for the plasma, various forms of feedback controls are derived by minimizing an instantaneous weighted mean outflow rate over a subregion of the shell. The effects of some of the derived feedback controls on plasma confinement are determined by experiments performed on a two-dimensional computer simulated plasma. Author (TAB)

N70-40267# Miami Univ., Coral Gables, Fla. Center for Theoretical Studies.
STOCHASTIC PROCESSES AND RELATIVISTIC PLASMA Final Report, 1 Jan. 1968 – 31 May 1970
Behram N. Kursunoglu and Arnold Perlmutter 5 Jun. 1970 13 p refs
(Contract F44620-68-C-0033)
(AD-708182; AFOSR-70-1645TR) Avail: NTIS CSCL 20/9

The research covered by the report is concerned with a number of fundamental aspects of plasma behavior and with some peripheral topics in statistical mechanics and electromagnetic theory. A considerable portion of the effort has been based on applications of symmetry approaches from theoretical physics to plasma problems. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N70-39035 Maryland Univ., College Park.
THERMAL CONDUCTIVITY OF MERCURY AT LIQUID HELIUM TEMPERATURES
Aristides Tzannetis Serlemitsos (Ph.D. Thesis) 1969 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-18529

The thermal conductivity of mercury in the temperature range 1.15 to 4.45 K has been investigated very thoroughly. The measurements were carried out on polycrystalline samples of high purity mercury and the temperature dependence of the conductivity both in the normal and superconducting state was studied. In the normal state the conductivity deviates from 1/T squared dependence which results when a Debye phonon spectrum is considered. A model for the phonon spectrum, resembling the actual spectrum, is introduced. In terms of this model the deviations from the 1/T squared dependence can be qualitatively understood. This same model helps one understand the temperature dependence of the conductivity in the superconducting state at temperatures away from the superconducting transition temperature. It may also form the basis for calculations giving the behavior of the conductivity in the neighborhood of the superconducting transition temperature. The results indicate that the conductivity may be anisotropic in absolute value. However, the temperature dependence of the conductivity does not show any anisotropy. Some possible sources of an anisotropy in the thermal conductivity are discussed. Dissert. Abstr.

N70-39036 Dartmouth Coll., Hanover, N.H.
THE EXCITON–PHOTON INTERACTION IN HELICAL POLYMERS
Frederick Meers Loxsom (Ph.D. Thesis) 1969 271 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 69-18658

The exciton modes of a molecular crystal are represented in a second-quantization form by a model Hamiltonian which may be exactly diagonalized by the Bogoljubov canonical transformation. The connections between theories based either on one-electron functions or one-molecule functions are discussed. Frenkel and Wannier exciton modes of the molecular crystal are represented by this formalism. The exciton–photon interaction is formulated, and the retardation term in the interaction coefficient is retained. The polariton modes of the molecular crystal are found by a Bogoljubov canonical transformation of the total exciton–photon Hamiltonian. The secular equation for those polariton modes which represent electromagnetic waves propagating in a dispersive medium is solved, and a general refractive index is defined. The general refractive index is used for the formulation of the optical dispersion and optical activity of the molecular crystal in terms of molecular moments, energies, and the intermolecular interaction. Dissert. Abstr.

N70-39039 California Univ., Berkeley.
DIRECT OBSERVATION OF MOBILITY OF DISLOCATIONS IN DEFORMED SILICON BY X-RAY LANG TOPOGRAPHY
Vugranam Chakravarthy Kannan (Ph.D. Thesis) 1969 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-18940

Measurements of glide velocities of isolated individual dislocations as a function of temperature in the range 775 to 920 C were made in silicon single crystals by X-ray Lang topography and the data was correlated with the appearance of the dislocation lines. Qualitative information was also obtained on the mobilities of dislocations at temperatures around approximately 1000 C as well as on the generation and multiplication of dislocations during the initial stages of plastic deformation in highly perfect crystals. Under stresses far below the macroscopic yield point, dislocation generation invariably took place at or near the surfaces. Vacancy clusters or loops in a few quenched and aged specimens did not act as sources but rather were obstacles to the passage of dislocations. Although the average direction of all dislocations was along <110> none of the lines were perfectly straight suggesting that the Peierl's stress is not high enough to align the dislocations along the close-packed directions. Dissert. Abstr.

N70-39049# Columbia Univ., New York. Henry Krumb School of Mines.
DEFECTS IN CRYSTALS Annual Report, 1 Mar. 1969 – 28 Feb. 1970
A. S. Nowick 28 Feb. 1970 38 p refs
(Contract AT(30-1)-3712)
(CU-3712-16) Avail: NTIS

Research dealing with dielectric relaxation in alpha-quartz crystals was begun as a prelude to a study of the piezoelectric

relaxation phenomenon. Two new dielectric relaxations were discovered in certain synthetic crystals, and both relaxation appear to be due to the same defect. Work on the intermetallic compound MgZn2 is described which is aimed at obtaining a relaxation effect due to a single substitutional atom or a single vacancy. Author

N70-39085 New Mexico State Univ., University Park.
PHENOMENOLOGICAL THEORY OF REFRACTIVE INDEX AND ELECTRO-OPTICAL PHENOMENA IN CRYSTALS OF PEROVSKITE STRUCTURE (WITH APPLICATION TO BARIUM TITANATE)
Donald Coolidge Wunsch (Ph.D. Thesis) 1969 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-18487

A description is given of a point dipole model which can be used to calculate the refractive indices and electro-optical phenomena in crystals of perovskite structure. Electro-optical effects are calculated by use of the model for the specific case of barium titanate and comparison is made with experimental values. The principal addition to previously used point dipole models is an anisotropic field-dependent electronic polarizability. The field dependence of the polarizability is derived from quantum mechanical considerations. The resulting expression is useful even for very strong fields. The introduction of an anisotropic field-dependent polarizability into the crystal model establishes a mechanism which can account for the natural birefringence in the tetragonal phase of many crystals and provides the basis for the Pockel and Kerr electro-optic effects. A general expression for the Coulomb fields in a tetragonal lattice based on the Ewald method of lattice sums is used to calculate the Coulomb fields in tetragonal barium titanate. This method takes into account the entire lattice rather than just nearest neighbor ions. Dissert. Abstr.

N70-39105 Carnegie-Mellon Univ., Pittsburgh, Pa.
MECHANICAL TWINNING OF SILVER
Kenneth Jay Davis (Ph.D. Thesis) 1969 216 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 69-19089

The results of the systematic variation of temperature, strain rate, and flow stress established the basic mechanical parameters which describe mechanical twinning. The initial and the average twinning stress were found to be independent of temperature and depend strongly on the flow stress of the crystal. The stress of initiation and propagation of twinning decreases with increasing strain rate. The results are consistent with the view that mechanical twinning and cross slip are competing processes. When the possibilities of cross slip at local stress concentrations are inhibited, deformation takes place by twinning. Dissert. Abstr.

N70-39118 Polytechnic Inst. of Brooklyn, N.Y.
THE EXTRAORDINARY HALL EFFECT IN PARAMAGNETIC GADOLINIUM FILMS
Francine J. Wald (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-17805

The extraordinary Hall coefficient was measured in paramagnetic gadolinium films in a temperature range up to 65 deg above the Curie point using a previously developed technique for studying ferromagnetic resonance in thin films through non-linear microwave interactions. This resonance method creates a dynamic situation in which the alignment of the magnetic fields is upset, thereby making separation of the ordinary and extraordinary contributions to the total Hall effect feasible. In order to establish the applicability of the theoretical analysis, films of different thickness were examined; their quality relative to bulk gadolinium was determined by dc measurements. The dc and microwave measurements were made as a function of temperature and film thickness. Measurements show that at microwave frequencies the extraordinary Hall constant is independent of temperature between 305 and 360 C. Dissert. Abstr.

N70-39188 Purdue Univ., Lafayette, Ind.
THE 5 mm CYCLOTRON RESONANCE IN p-TYPE INDIUM ANTIMONIDE
Hanno Tiit Tohver (Ph.D. Thesis) 1969 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-17282

The carrier concentrations at 77 K ranged from 5.5 × 10 to the 13th power/cc with Hall mobilities of 7000 sq cm/v-sec. The dislocation counts varied from 800/sq cm to undetectable. Below 8 K weak photoconductivity peaks at effective mass values of 0.22 + or − 0.03 m sub o, 0.45 + or − 0.05 m sub o, and 0.85 + or − 0.05 m sub o were detected in a large background. The symmetry and mass values of these peaks do not agree with the ellipsoidal heavy hole band structure expected from the lack of a center of inversion in the indium antimonide lattice. No effects from inversion asymmetry were detected at temperatures as low as 2 K. Above 10 K, in the classical region, heavy hole masses with omega tau values of 2.5 and light hole masses with maximum omega tau values of 1.3 were found. The power dependence of the light hole linewidth and comparisons of the heavy hole lineshapes with theoretical ones suggest that approximately 10 to the 14th power/cc charged recombination centers contribute significantly to the linewidths at 13 K. Dissert. Abstr.

N70-39228# North Dakota Univ., Grand Forks.
CONTACT POTENTIAL CHANGE ACCOMPANYING SIZE EFFECT SEMIMETAL TO SEMICONDUCTOR TRANSITION
Peter N. Johnson and Henn H. Soonpaa [1969] 7 p refs Presented at the Conf. on the Phys. of Semimetals and Narrow Gap Semicond., Dallas
(Contract AT(11-1)-1699)
(COO-1699-15; CONF-700312-1) Avail: NTIS

Contact potential measurements on films of Bi8Te7S5 show that the Fermi energy of a size effect quantized semimetal changes as a function of thickness in accordance with theory. Author

N70-39357 Arizona Univ., Tucson.
INVESTIGATION OF ELECTRON TRAPPING PHENOMENA IN METAL OXIDE INSULATORS
Paul Shiflet Pickard (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-18396

Electron trapping in metal oxide insulators was investigated theoretically and experimentally using thermally stimulated currents (TSC). A theoretical model from energy band theory was developed and used as the basis of a general analysis which described the currents from thermal stimulation for arbitrary retrapping rates. This analysis employed the concept of an effective thermal emission probability (ETEP). A general expression was obtained for the TSC curve. An equation was derived from the ETEP analysis which can be used to calculate the trap cross section when fast retrapping occurs. A method of obtaining the carrier mobility from TSC data was also developed from this general analysis. Dissert. Abstr.

N70-39456*# Northrop Corporate Labs., Hawthorne, Calif.
STUDY OF DOPANTS FOR RADIATION-RESISTANT SILICON Final Report
R. F. Bass, O. L. Curtis, Jr., and J. R. Srour Aug. 1970 59 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952523)
(NASA-CR-113550; NCL-70-51R) Avail: NTIS CSCL 20L

The results are described of investigations of the effects of gamma irradiation on the electrical properties (primarily carrier lifetime) of both Al-and Li-doped silicon. The results of initial studies of the radiation sensitivity of Li-doped material were rendered uncertain due to an inhomogeneous distribution of Li throughout the bulk of the silicon samples employed. Subsequently, a procedure was developed involving a diffusion and distribution cycle employing considerably longer times and higher temperatures than previously

used. Use of this technique resulted in the preparation of a considerably more homogeneous Li-doped sample. Studies of Al-doped material demonstrate that Czochralski-grown Al-doped Si that undergoes an appreciable resistivity change upon heat treatment apparently is significantly less sensitive to gamma irradiation than comparable B-doped crucible-grown material. It is felt that these findings constitute an important breakthrough that may have significant impact on future solar cell technology. Author

N70-39469# Office of Naval Research, London (England).
IMPERIAL COLLEGE MEETING ON ION TRANSPORT IN SOLID INSULATORS
Lawrence M. Slifkin 20 Apr. 1970 9 p refs
(AD-707325; ONRL-C-12-70) Avail: NTIS CSCL 20/12

The report describes the papers given at a conference on diffusion of ions in non-conducting solids. Most of the papers dealt with oxides, and considerable emphasis was placed on those systems relevant to solid state devices. Author (TAB)

N70-39471# Office of Naval Research, London (England).
MASS TRANSPORT IN NON-METALLIC SOLIDS
Lawrence M. Slifkin 13 Apr. 1970 14 p refs Conf. held at London, 17 – 18 Dec. 1969
(AD-707323; ONRL-C-10-70) Avail: NTIS CSCL 20/12

A conference on ionic diffusion and conductivity in such crystals as oxides, monovalent halides, and alkaline earth halides took place in London on 17/18 December TAB

N70-39506# Academy of Sciences (USSR), Moscow. Physics Inst.
SPIN ECHO IN NONFERROMAGNETIC METALS
I. S. Baikov 1970 13 p refs In RUSSIAN
(NP-18254) Avail: AEC Depository Libraries

The theory of linearized spin echo in a degenerate electron gas was applied to the case of an arbitrary oriented spin wave vector and magnetic field gradient in relation to the direction of the external magnetic field. It is shown that spin-echo experiments can be used for determining the virtual part of the generalized spin-wave diffusion coefficient. Author (NSA)

N70-39618# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
CONFIGURATION MIXING OF SUBSIDIARY MINIMA: CORRECTIONS TO THE GROUND STATE WAVE FUNCTION FOR DONORS IN SILICON
T. G. Castner, Jr. [1969] 98 p refs Sponsored by AEC
(UR-3388-19) Avail: NTIS

The introduction of wave function components from the region of the L sub 1, k sub 1, and U sub 1 points of the lowest conduction band into the ground state wave function of the shallow donors As, P, and Sb is shown to substantially improve the agreement between the calculated Fermi contact constants for identified ENDOR shells and the experimental Fermi contact constants measured by Hale and Mieher. This wave function admixture is calculated employing first order perturbation theory. The calculated results indicate the positive identification of two new ENDOR shells, shell C as site (5,5,5) and shell F as site (2,2,0), and suggest the tentative identification of nine other ENDOR shells with lattice sites. A noninversion component of wave function was introduced. This subidiary minima admixture approach was attempted for the deep donor S(+), yielding an improved qualitative agreement between theory and experiment. It is shown the valley-valley coupling terms account for nearly all the energy correction of the 1s-A sub 1 state and that the single valley correction is very small. Author (NSA)

N70-39677# George Washington Univ., Washington, D.C. Inst. for the Study of Fatigue Fracture and Structural Reliability.
DAMPING OF DISLOCATIONS IN NIOBIUM BY PHONON VISCOSITY
Warren P. Mason and Douglas E. MacDonald Jun. 1970 29 p refs
(Contract N00014-67-A-0214-0011)
(AD-707786; TR-3) Avail: NTIS CSCL 20/12

Attenuation measurements have been made of the body centered crystal niobium for three waves along the <110> direction. The room temperature measurements are consistent with dislocations lying in the (110) planes with glide directions along the <100> axes. The fast shear has the largest attenuation and it has been measured over a temperature range from 30K to 300K with frequencies from 10 MHz to 150 MHz. The attenuation can be divided into a square-law attenuation and a dislocation component. The dislocation component can be used to evaluate a drag coefficient which is nearly constant down to 78K. It rises at low temperatures indicating an electron drag effect. The constant region is consistent with a phonon viscosity damping with a crystal having a peak in the thermal conductivity. The electron drag confirms a theoretical calculation giving a drag inversely proportional to the electrical resistivity. Author (TAB)

N70-39700# New York Univ., N.Y. Radiation and Solid State Lab.
MECHANISMS OF ENERGY TRANSFER IN DIELECTRICS Final Report, 1 Feb. 1966 – 31 Jul. 1969
Werner Brandt Dec. 1969 28 p
(Contract DA-28-043-AMC-01999(E))
(AD-707931; ECOM-01999-F) Avail: NTIS CSCL 20/12

The positron through its annihilation characteristics is being used as a probe to determine the scattering cross sections needed to describe transient electronic effects in insulators such as polyethylene and polytetra-fluorethylene. Positive-ion defects in non-metal crystals are studied using positrons. A correlation has been observed between the intensity of the long-lived component of the positron decay spectrum and the positive-ion vacancy concentration. Author (TAB)

N70-39706# Yale Univ., New Haven, Conn. Dept. of Physics and Engineering and Applied Sciences.
STUDY OF IDEAL MAGNETIC CRYSTALS Annual Progress Report, 1 Jun. 1969 – 31 May 1970
Werner P. Wolf 31 May 1970 19 p refs
(Contract AT(30-1)-3227)
(YALE-3227-63) Avail: NTIS

Experimental research progress is reported on crystal preparation, low frequency susceptibility and relaxation in single crystals of Dy(OH)3, high frequency relaxation measurements, magnetothermal measurements, electron spin resonance, nuclear magnetic resonance, and neutron scattering. N.B.

N70-39708# Iowa State Univ. of Science and Technology, Ames.
THE CRYSTAL STRUCTURES OF COMPOUNDS INVOLVING METAL-METAL BONDING. 1: Gd 8 Cl 12. 2: Te 4(AlCl 4)2
Donald Arthur Lokken (Ph.D. Thesis) Feb. 1970 61 p refs
(Contract W-7405-eng-82)
(IS-T-348) Avail: NTIS

Crystal growth and single crystal X-ray diffraction studies were performed on Bi5(AlCl4)3, Gd8Cl12 and Te4(AlCl4)2. Crystals of Bi5(AlCl4)2 were grown by slowly cooling the reduced Bi-BiCl3-AlCl3 melt, by recrystallization from molten salt solvents, and by vapor-phase transport via a chemical transport reaction. The crystal structure was not solved because of difficulty caused by extensive twinning. The crystal structures of Gd8Cl12 and Te4(AlCl4)2 were determined from 3-dimensional diffractometer data taken with MoK alpha radiation. The refinements of the structural parameters were performed by full-matrix least square methods using atomic scattering factors corrected for anomalous dispersion. Refinements were made by using both isotropic and anistropic thermal parameters. Author

N70-39726# Illinois Univ., Urbana. Dept. of Physics and Materials Research Lab.
ATOM TRANSPORT UNDER VARYING PRESSURE
D. Lazarus, D. N. Yoon, and R. N. Jeffery Jun. 1970 23 p refs
(Contract AT(11-1)-1198)
(COO-1198-736) Avail: NTIS

Results are given for measurements to pressures of 7 kilobars of ionic conductivity in a series of pure and doped alkali halides: NaCl, KCl, NaBr, and KBr, all of which are predominantly cationic vacancy conductors. The activition volumes are found to be pressure dependent in the intrinsic regions. In all cases the Schottky pair vacancy formation volume is found to be larger than the molar volume, the ratio being largest for NaCl and smallest for KBr. Results are also given for the total activation volume for diffusion of Ti-44 in beta-Ti, a case of anomalous bulk diffusion. The tracer penetration plots do not follow a perfect Gaussian profile. However, if the penetration plots are fit to a single Gaussian, the activation volume derived is consistent with that expected for a vacancy mechanism in bcc metals. Author

N70-39759# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
DYNAMIC THEORY OF X-RAYS IN CRYSTALS WITH DEFECTS
A. M. Afanasev and V. G. Kon 1969 38 p refs In RUSSIAN; ENGLISH summary
(IAE-1890) Avail: AEC Depository Libraries

Sets of integral equations are obtained that describe the X-ray diffraction in crystals with defects. A simple description of defects is suggested both for weekly as well as strongly distorted regions of the crystal. In the case of ideal crystals, the equations give a simple means of determination of wave fields in the crystal with an arbitrary incident beam distribution. For Bragg diffraction, the problem is solved for the first time, the solution being given for crystals of arbitrary thickness. For distorted crystals, the integral equations permit a universal treatment of both weakly and strongly distorted regions. The problem of image determination from strongly distorted regions is confined to the problem of solving of a simple one-dimensional integral equation. The first iteration approximation of the initial integral equations is shown to give the results obtainable by Fourier analysis, with the defect being treated as a small perturbation. Author (NSA)

N70-39762# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
THICKNESS-TWIST VIBRATIONS OF A QUARTZ STRIP Interim Technical Report
R. D. Mindlin Jul. 1970 13 p refs
(Contracts DA-28-043-AMC-01731-(E); Nonr-4259(13))
(AD-708057; TR-15; ECOM-01731-5; ITR-5) Avail: NTIS CSCL 20/12

An exact solution of the three-dimensional equations of elasticity was found for the thickness-twist modes of vibration of a rotated-Y-cut quartz plate with a pair of parallel, free edges. The solution has a simple form: made possible by relaxing the condition that the edge-planes be perpendicular to the main faces of the plate. For the AT-cut, the edges are off perpendicular by about five degrees. Author (TAB)

N70-39772*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OBSERVATION AND MECHANISM OF DIRECT-CURRENT QUENCHING OF ALTERNATING CURRENT ELECTRO-LUMINESCENCE IN TYPICAL ZINC SULFIDE PHOSPHORS
Edmund J. Conway Washington Sep. 1970 37 p refs
(NASA-TN-D-5979; L-5355) Avail: NTIS CSCL 20L

The reduction or quenching produced by a dc voltage on light emitted during ac electroluminescence was studied for zinc sulfide phosphor powders. The zinc sulfide was activated with copper and coactivated with either manganese, chlorine, or bromine. Quenching occurred only for cells which exhibited electrical conductivity greater than approximately 10 to the minus 12th power (ohms-cm) to the minus 1st power. The fractional reduction in brightness approached zero as the ac voltage was increased, but it increased linearly with increasing dc voltage. The time dependence of quenching was approximately that of a square wave, and the magnitude of quenching was found to be independent of ac frequency from 0.2 kHz to 1 kHz. Spectrally, quenching was uniform for chlorine- and bromine-coactivated phosphors. The two-emission-band ZnS:Cu,Mn phosphor exhibited quenching for the blue emission band but enhancement for the yellow emission band. These observations are explained in terms of the deexcitation of luminescence centers followed by the space charge limited conduction of holes to the surface of the crystallite and nonradiative recombination of the holes with conduction electrons from the binder. Author

N70-39858# Aerojet-General Corp., Sacramento, Calif. Materials Research Lab.
PHASE EQUILIBRIA INVESTIGATION OF BINARY, TERNARY, AND HIGHER ORDER SYSTEMS. PART 10: THE CRYSTAL STRUCTURES OF Hf 3 N 2 AND Hf 4 N 3
Erwin Rudy Wright-Patterson AFB, Ohio AFML Mar. 1970 22 p refs
(Contract F33615-67-C-1513)
(AD-708176; AFML-TR-69-117-Pt-10) Avail: NTIS CSCL 20/2

The crystal structures of epsilon- Hf3 N2 and zeta- Hf4 N3 were determined from X-ray powder photographs. TAB

N70-39859# Cornell Univ., Ithaca, N.Y. Materials Science Center.
GROUND STATE OF THE INHOMOGENEOUS BOSE LIQUID
David Sheldon Hyman (Ph.D. Thesis) Jan. 1970 107 p refs
(Contract AT(30-1)-3699; Grant NSF GP-9402)
(NYO-3699-42) Avail: NTIS

The properties of rotating ideal quantum gases and thin liquid helium films are studied at the absolute zero of temperature. A trial wave function is constructed that describes uniform rigid-body rotation of a large number of noninteracting fermions. This wave function is adapted to treat the corresponding ideal Bose gas, with essentially identical physical results. The energy of the latter system is evaluated exactly, and it is found to be many orders-of-magnitude greater than the energy corresponding to one quantized vortex line of the same total angular momentum. Three different approaches are used to construct a simple model of the ground state of a liquid helium film. The most useful model is studied in detail numerically. This study relies on the use of well-known approximation methods in the theory of classical fluids to perform approximate calculations of the energy from a class of trial wave functions. In the context of these calculations, the model is found to be partially successful in describing thin helium films. The difficulties with the theory, and possible ways to overcome them, are discussed in detail. Author (NSA)

N70-39914*# Advanced Kinetics, Inc., Costa Mesa, Calif.
STUDY OF INFRARED RADIATION FROM SEMICONDUCTOR DEVICES Final Technical Report
10 Jun. 1970 89 p refs
(Contract NAS12-2199)
(NASA-CR-113573) Avail: NTIS CSCL 20L

The possibility of conducting diagnostic studies of semiconducting devices by analysis of the radiation emitted under operating conditions is investigated. The radiative output can be interpreted not only in terms of dissipative effects within the bulk of the device but also in terms of properties related to the charge carriers and to the electronic structure of the semiconductor. Thus, it is immediately evident that any diagnostic technique developed for this purpose must be based on a reliable theoretical model of the mechanism generating the radiation. Two main classes of

effects are expected to contribute to this radiative emission. The first category covers thermal emission. This component of the radiation is indicative for dissipative effects in the device and the profile of the emission is the result of local heat deposition and of thermal diffusion in the slab. The second mechanism is attributable to carrier recombination effects in the solid and hence this component is of non-thermal origin. The central problem in this investigation concerns the differentiation between these two contributions and the evaluation of the radiative emission expected from a generalized slab of semiconducting material. Author

N70-40015* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPARATUS FOR PRODUCING HIGH PURITY SILICON CARBIDE CRYSTALS Patent

Noel T. Wakelyn and Robert A. Jewell, inventors (to NASA) Issued 18 Jan. 1966 (Filed 25 Sep. 1963) 5 p Cl. 23-277 Continuation-in-part of US Patent Appl. SN-221637, filed 5 Sep. 1962

(NASA-Case-XLA-02057; US-Patent-3,230,053; US-Patent-Appl-SN-320595) Avail: US Patent Office CSCL 20B

A device is described for producing small quantities of high purity silicon carbide on a carbon base by the hydrogen reduction of silicon tetrachloride, with crystals being developed from the gaseous phase of the reactive materials. Hydrogen gas is saturated with silicon tetrachloride and flowed under pressure through a constricted passageway within a high temperature furnace, onto a carbonaceous base or model member. The carbonaceous member extends forward and aft of the constricted furnace area with silicon carbide crystal formation on the carbon model only on the portion positioned aft of the constricted gaseous passageway. R.B.

N70-40022*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

ELECTRICITY MEASUREMENT DEVICES EMPLOYING LIQUID CRYSTALLINE MATERIALS Patent Application

Andre Garfein, Wilhelm Rindner, and David Rubin, inventors (to NASA) Filed 17 Jun. 1970 20 p

(NASA-Case-ERC-10275; US-Patent-Appl-SN-47061) Avail: NTIS CSCL 09E

Measuring instruments utilizing liquid crystalline elements that exhibit visible change in response to input signals above given threshold levels are described. By applying the input signals nonuniformly so that the threshold value is exceeded in only certain portions of the liquid crystalline element, visible discontinuities are created. The locations of these discontinuities are made dependent on the magnitudes of the input signals, direct readouts of which are provided by suitably calibrated indicia. NASA

N70-40041# Naval Research Lab., Washington, D.C. Metal Physics Branch.

ELECTRON-PARAMAGNON INTERACTION EFFECTS IN NEARLY FERROMAGNETIC METALS Final Report

A. I. Schindler 21 May1970 27 p refs

(AD-707712; NRL-7057) Avail: NTIS CSCL 20/12

The effects of itinerant spin-sensity fluctuations, or paramagnons, on various physical properties including the electronic specific heat coefficient gamma, the low temperature electrical and thermal resistivities, and the ideal Lorenz number were reviewed. Paramagnon interaction effects, which are important in determining the low-temperature properties of strongly-exchange-enhanced paramagnetic metals like palladium, can be strongly modified by alloying additions, in particular nickel. The exchange enhancement increases with nickel content until, at some critical composition, the system goes ferromagnetic. Two models have been introduced to explain the properties of such alloys. In the one model, the uniform enhancement model, it is assumed that the effect of alloying with nickel may be represented by an increase in the exchange enhancement of the matrix. In the other model, the local enhancement model, the alloy is treated in a scheme valid in the dilute limit, where the spatial inhomogeneities of the spin density fluctuations in the vicinity of the nickel site are taken into account. Both of these models were examined and compared with experimental observations of Pd, Pt, and Rh with alloying additions of Ni. The theoretical calculations of various composition-dependent and temperature-dependant effects gave, in almost all cases, reasonable, but somewhat large, estimates for their magnitudes. Author (TAB)

N70-40096# Clemson Univ., S.C. Dept. of Physics.

THE EFFECT OF LARGE ELASTIC STRAIN ON SEVERAL CRYSTAL PROPERTIES Final Report

M. J. Skove and E. P. Stillwell 27 May 1970 8 p refs

(Grant AF-AFOSR-1548-68)

(AD-707854; AFOSR-70-1283TR) Avail: NTIS CSCL 20/12

The effect of large elastic strains on the superconducting transition temperature (T sub c) and on the elastic constants of several metals was measured. The effect of size on the electrical resistance and on (T sub c) was examined. The effect of fluctuations on the resistance of nearly one dimensional samples near (T sub c) was observed. Author (TAB)

N70-40111# Naval Research Lab., Washington, D.C.

NONLINEAR EFFECTS IN THE MIGRATION OF CONDUCTING AND NONCONDUCTING ELEMENTARY EXCITATIONS IN A1B7 AND A2B6 CRYSTALS [NELINEINYE EFFEKTY PRI MIGRATSII BESTOKOVYKH I TOKOVYKH ELEMENTARNYKH VOZBUZHDENII V KRISTALLAKH A1B7 I A2B6]

B. N. Gorbachev 19 Jun. 1970 18 p refs Transl. into ENGLISH from Radiats. Fiz. (USSR), v. 4, 1966 p 85-97

(AD-708187; NRL-Trans-1207) Avail: NTIS CSCL 20/12

The following items are discussed: Experimental investigation of nonlinear effects in the migration of excitons and electron-hole pairs in A1B7 crystals; Experimental investigation of nonlinear effects in the migration of electron-hole pairs in A2B6 crystals; Comparison of nonlinear effects in A1B7 and A2B6 crystallophosphors; Nonlinear effects in photon multiplication; and Nonlinear effects and the problem of the alpha/beta-ratio. TAB

N70-40119# California Univ., Berkeley. Electronics Research Lab.

STUDY OF NEUTRON DAMAGE TO SEMICONDUCTORS USING JUNCTION DEVICES Final Report, 23 Jul. 1968 - 13 Nov. 1969

W. G. Oldham Nov. 1969 55 p refs

(Contract DAAG-39-69-C-0004)

(AD-707984; ERL-69-9; Rept-69-9) Avail: NTIS CSCL 20/12

Detailed measurements on special gated Si p+n diodes yield the damage parameters associated with the three basic current components in p-n junctions. Recombination in the neutral bulk, recombination and generation in the space-charge region, and recombination and generation at the surface are characterized over a wide range of neutron doses and injection levels. Author (TAB)

N70-40120# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

STRUCTURAL MODEL FOR AMORPHOUS SILICON AND GERMANIUM

D. E. Polk May 1970 23 p refs

(Contract N00014-67-A-0298-0009)

(AD-707772; TR-29) Avail: NTIS CSCL 20/2

A model for amorphous germanium and silicon has been constructed using the random network concept. Each atom has a first coordination number of four, and only a small variation in the nearest neighbor distance is allowed. Non-crystallinity is due to variations in the tetrahedral bond angle and rotations about bonds. No difficulty was encountered in continuing to make the model larger and no difference between the central and outer regions could be observed. The radial distribution function and the density of the model agree well with recent measurements. Author (TAB)

N70-40175# Illinois Univ., Urbana. Coordinated Science Lab.
THE EFFECT OF STRESS ON THE LUMINESCENCE SPECTRUM OF IRRADIATED SILICON
Colin Elliott Jones (Ph.D. Thesis) May 1970 203 p refs
(Contract DAAB07-67-C-0199)
(AD-707690; R-466; UILU-ENG-70-211) Avail: NTIS CSCL 20/12

Silicon crystals which have been irradiated with neutrons, high energy electrons, or gamma-rays at room temperature show two strong luminescence bands in the near infrared. Both bands have a sharp zero-phonon line followed by a series of broad phonon assisted peaks. The higher energy band associated with a zero-phonon line at 0.97 eV is independent of any impurities while the lower energy band with a zero-phonon line at 0.79eV is seen only in silicon containing oxygen. Data on the temperature and stress dependence of the luminescence bands have been taken in order to obtain information on the type of defects and the optical transitions involved. The narrow line widths observed for the zero-phonon lines show that the transitions do not involve a free carrier. The zero-phonon line at 0.79eV is a doublet showing thermal population effects which relate it to two levels in the initial state. The lack of any association with impurities, the annealing, and the stress data for the bands associated with the 0.97 eV zero-phonon line all support an identification of these bands, with divacancy. Author (TAB)

N70-40190# Duke Univ., Durham, N.C. Dept. of Physics.
LOW TEMPERATURE PHYSICS Final Report, 22 Feb. 1967–21 Feb. 1970
Henry A. Fairbank 21 Feb. 1970 7 p refs
(Contract DA-ARO(D)-31-124-G895)
(AD-707951; AROD-7071-9-P) Avail: NTIS CSCL 20/12

The report provides a brief summary of the scientific achievements gained in a three-year study of low temperature physics. Topics include second sound in solids, thermal conductivity and Poiseuille flow in a phonon gas, superconducting semiconductors, and second sound in dilute helium 3 - helium 4 mixtures. A list of publications emanating from the project, and a roster of scientific personnel are also provided. Author (TAB)

N70-40235# Boeing Scientific Research Labs., Seattle, Wash.
ELECTRON IMPACT STUDY OF INSULATOR SURFACES LiF AND NaF
P. S. P. Wei May 1970 18 p refs
(AD-708804; D1-82-0982) Avail: NTIS CSCL 20/12

The techniques of LEED and electron energy loss measurements are used to study the (100) surfaces of LiF and NaF. The surface charging voltage is related, the first cross-over voltage for unity secondary yield, and is found to be temperature dependent. The energy loss spectrum is shown to be characteristic of the surface studied. The limitation of the retarding field method is discussed. Author (TAB)

N70-40241# South Dakota School of Mines and Technology, Rapid City. Dept. of Pysics.
LOW-TEMPERATURE THERMAL CONDUCTIVITY MEASUREMENTS IN SEMICONDUCTORS Final Report, 1 Jul. 1969–31 May 1968
Daniel R. Redin 15 Jun. 1970 28 p refs
(Contract N00014-69-A-0100-0001)
(AD-707749; F00014) Avail: NTIS CSCL 20/12

Thermal conductivity measurements have been made at low temperatures on a heavily doped p-type sample of InSb and on the magnetic semiconductors EuO and EuS in the vicinity of their Curie temperatures. Further evidence of an anomaly in the thermal conductivity of EuO in the vicinity of its Curie temperature of 69 K was obtained but during the course of continuing measurements the anomaly disappeared. The cause of the change in behavior is believed due to a breakdown, on a microscopic scale, of the pressed-powder sample. The thermal conductivity of a pressed-powder EuS sample showed a predominantly T squared temperature dependence over the temperature range 13.5 K to 17.6 K. There was no evidence of any anomalous behavior near the Curie temperature of 16.4 K. Extension of thermal conductivity measurements down to 17 K now has made available thermal conductivity values from 17 K to 640 K for a polycrystalline sample of InSb containing 10 to the 20th power acceptors per cc. A theoretical analysis of the results indicates that throughout this temperature range the thermal conductivity is due primarily to high-frequency transverse acoustic phonons with a small contribution due to high-frequency longitudinal phonons. The conductivity due to low-frequency transverse and longitudinal phonons is negligible due to strong scattering by holes. Author (TAB)

N70-40345# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
PIEZOELECTRIC AND ELASTIC SURFACE WAVES ON LiNbO3
Ronald Neil Spaight Dec. 1969 88 p refs
(Contract F33615-68-C-1034)
(AD-708708; ERI-62900) Avail: NTIS CSCL 20/12

Elastic and piezoelectric surface wave propagation on trigonal crystals is investigaed. Propagation along the trigonal axis is chosen so that decoupling into a transverse mode and a Rayleigh mode will occur. It is demonstrated that the transverse mode cannot exist under the restriction that the decay constants be pure imaginary numbers. This restriction requires pure attenuation away from the propagation face. The Rayleigh wave is shown to exist as a generalized Rayleigh mode on LiNbO3. A numerical technique is employed to obtain detailed information about the particle displacement variation with depth in the material. Experimental work was performed to determine the propagation velocity on LiNbO3. The results of this work found the velocity to be 3520 m/sec. TAB

N70-40348# Lockheed Missiles and Space Co., Palo Alto, Calif.
DIFFRACTION REFLECTION AND PASSAGE OF X-RAYS IN IDEAL CRYSTALS
A. V. Kolpakov [1970] 6 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. III, Fiz., Astron. (Moscow), no. 2 1970 p 130–135
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A nonlocal coupling between the electrical induction and field intensity vectors is introduced in examining X-ray diffraction in ideal crystals. This allows reduction of the problem to the propagation of coupled diffusion waves. As an illustration, the two-ray problem of refraction and passage is solved. The method of shortened equation is used as the method of solution. Author

N70-40356# Purdue Univ., Lafayette, Ind. Dept. of Physics.
INVERSION-ASYMMETRY SPLITTING OF THE CONDUCTION BAND IN GaSb FROM SHUBNIKOV-de HAAS MEASUREMENTS
D. G. Seiler, W. M. Becker, and Laura M. Roth (GE, Schenectady, N.Y.) Repr. from Phys. Rev. B, v. 1, no. 2, 15 Jan. 1970 p 764–775 refs
(Contract DA-31-124-ARO(D)-17)
(AD-707994; AROD-6782-24-P) Avail: NTIS CSCL 20/12

A detailed experimental investigation has been carried out on the beating patterns seen in the Shubnikov-de Haas oscillations in Te-doped n-GaSb. Results are discussed. TAB

N70-40365# Aerojet-General Corp., Sacramento, Calif. Materials Research Lab.
PHASE EQUILIBRIA INVESTIGATION OF BINARY, TERNARY, AND HIGHER ORDER SYSTEMS. PART 8: THE STRUCTURE OF A TERNARY PHASE T3C2 IN THE V-Ta-C SYSTEM
Erwin Rudy Wright-Patterson AFB, Ohio AFSC Apr. 1970 22 p refs

(Contract AF 33(615)-67-C-1513)
(AD-708476; AFML-TR-69-117-Pt-8) Avail: NTIS CSCL 11/2

The crystal structure of Ta2VC2 was determined from X-ray powder photographs. The phase is stable from room temperature to above 2600C. The homogeneity range of 1650C varies between the limits (Ta1.80 to 2.04, V1.20 to 0.96)C1.74 to 1.80; the phase is thus substantially deficient in carbon. TAB

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N70-39508# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. Chemical Propulsion Information Agency.
CHEMICAL PROPULSION NEWSLETTER, FEBRUARY 1970
Feb. 1970 4 p refs
Avail: NTIS

News briefs are presented on the firing of a beryllium rocket motor, solid propellant dynamic burning rate prediction, plume technology, computer programs for prediction and correlation of liquid propellant thrust chamber performance, methods for measuring performance of air breathing propulsion systems, and test procedures for uniaxial tensile stress. R.B.

N70-39534*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
BIPROPELLANT DROPLET COMBUSTION IN THE VICINITY OF THE CRITICAL POINT
Robert Stephen Lazar (Ph.D. Thesis) Sep. 1970 143 p refs
(Grant NGR-39-009-077)
(NASA-CR-113596) Avail: NTIS CSCL 21I

An existing low pressure, variable property, steady droplet burning theory was extended for application to high pressure combustion. The extensions allowed for solubility of the ambient gases in the liquid phase and real gas effects at the droplet surface. Measurements were made of droplet burning rates in the combustion products of a flat flame burner at atmospheric pressure in order to serve as a baseline for the theory. Various alcohols and paraffins were tested at ambient temperatures from 1660 to 2530 K and ambient oxygen concentrations in the range 0 to 40% by volume. The theory (when corrected for flame zone dissociation) gave an adequate prediction of the variation in burning rate with changes in the ambient temperature and oxygen concentration. However, the theory progressively overestimated the burning rate as the fuel molecular weight increased, with errors as high as 50% for the heavier hydrocarbons. The failure was attributed to gas phase fuel decomposition near the droplet surface. Author

N70-39640# Labofina Societe Anonyme, Brussels (Belgium).
FUELS FOR SUPERSONIC AIRCRAFT [LES COMBUSTIBLES POUR AVIONS SUPERSONIQUE]
Thierry de Menten de Horne *In* AGARD Fuels, Lubricants, and Auxiliary Fluids for Supersonic and Hypersonic Aviation Jun. 1970 p 29–50 refs In FRENCH (See N70-39638 22-18)
Avail: NTIS

Estimates of fuel consumption in commercial aviation are considered for the years 1960 to 1985. The technical requirements of a fuel are examined, including caloric power provided, weak volatility, thermal stability, combustion characteristics, and behavior at low temperature. The use of additives to correct fuel faults is discussed with relation to the formation of static electricity, fuel stability during storage, microorganism activity in turbine fuels and resulting corrosion, and additives modifying the flow properties of kerosenes. Other solutions proposed for supersonic and hypersonic flights are mentioned, including cryogenic fuels and fuels derived from boron. Transl. by P.A.B.

N70-39653# Vitro Labs., Silver Spring, Md.
PHOTOCHEMICAL IGNITION OF GASEOUS FUEL-OXIDIZER MIXTURES AT SUBATMOSPHERIC PRESSURES Final Report, 1 Mar. 1967–28 Feb. 1970
A. E. Cerkanowicz, M. E. Levy, and R. F. McAlevy, III Apr. 1970 99 p refs
(Contract F44620-67-C-0068)
(AD-707879; VL-2432-3-0; AFOSR-70-1664-TR) Avail: NTIS CSCL 21/2

Experimental and analytical results are presented on the radiative initiation of sustained combustion in unsensitized, methane-oxygen-nitrogen and hydrogen-oxygen-nitrogen mixtures at room and slightly elevated temperatures and at fuel-oxygen partial pressures from 25 to 600 torr. Minimum irradiance required to photochemically initiate combustion, photochemical ignition delay time and reaction front propagation velocity were measured for the range of conditions stated above and for various wavelength ranges in the 1000–2000 A region. Author(TAB)

N70-39794*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROPULSION DIVISION
In its Space Programs Sum. No. 37-63, Vol. 3 30 Jun. 1970 p 167–235 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 21I

The advantages of laser ignition of explosive materials over presently used electrical methods are pointed out. Experiments with thin film metals show that more absorptive samples generate higher shock than more reflective materials. Solid propellant combustion studies include burning rate measurements, basic equations and mathematical modeling of combustion phases, and heat sterilization and vacuum storage effects on ignition of solid propellant rockets. A new solid propellant family, based on JPL 540J, has been developed that offers controllable mechanical properties of very high elongation and very low modulus by employing a binder formulation based on polymer network theory. G.G.

N70-39928# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS OF KEROSENE FUELS IN SMALL LABORATORY COMBUSTION CHAMBERS
Bogdan Wislicki 6 May 1970 20 p refs Transl. into ENGLISH from Tech. Lotnicza i Astronautyczna (Poland), v. 23, no. 4, 1968 p 12–68
(AD-708352; FTD-HT-23-156-70) Avail: NTIS CSCL 21/4

A number of small laboratory-type combustion chambers used to evaluate the properties of the kerosene-based fuels employed in jet aircraft engines are reviewed with respect to the effect of the physical and chemical characteristics of the fuels on the combustion process, as well as observations of secondary factors of that process - the interreaction of exhaust gases and engine components. Such observations are concerned with: the completeness of combustion; the stability of combustion; starting properties; ignition delay; combustion rate; tendency to deposit carbon scale; corrosion-erosion properties of combustion gases; effect of fuel additives on combustion process characteristics; effect of fuel additives on the corrosion and erosion caused by exhaust gases; resonance and vibrational combustion. Among the specific combustion chamber models described in the article are several developed and used in the US (Starkman, Evans, Phillips Petroleum Company, and Shell Oil Company), a Soviet-designed combustion chamber for studying the tendency of fuels to leave deposits (Chertkov, Ya. B., Zrelov V. N.: Novosti Neftyanoy Tekhniki, Neftesperabotka, No. 2, 1956, p. 12), another combustion chamber type Soviet burner, a West German Model described by G. Spengler, H. Gemperlein, and others. The principal characteristics of these laboratory combustion chambers are given. TAB

N70-40138# Consolidated Engineering Technology Corp., Mountain View, Calif.
BASIC METAL IGNITION AND COMBUSTION STUDIES

RELATING TO AIR-AUGMENTED COMBUSTION Final Report
Clarence L. Miller May 1970 106 p refs
(Contracts F44620-69-C-0055; F44620-68-C-0089)
(AD-707860; CETEC-FR-01700; AFOSR-70-1691TR) Avail: NTIS CSCL 21/2

A study was performed to investigate the ignition and combustion characteristics of boron particles in a two chambered test system. Such an apparatus was used in recognition of the results of an examination of the experimental unknowns associated with the ignition and combustion of metal particles under the conditions characteristic of an augmented system. The results indicated it was essential to separate the mechanisms of the heat up phase from those of the ignition and combustion phase in the particles combustion history. The theoretical analyses, experimental equipment, operational techniques and experimental results obtained in this investigation are described. TAB

N70-40300# ARO, Inc., Arnold Air Force Station, Tenn.
A SUMMARY REPORT OF THE CRYOSORPTION PUMPING OF HYDROGEN BY CARBON DIOXIDE FROST Final Report, Apr. – Sep. 1969
K. E. Templemeyer AEDC Jun. 1970 238 p refs
(Contract F40600-69-C-0001)
(AD-707844; AEDC-TR-70-123) Avail: NTIS CSCL 21/9.1

The sorption of hydrogen by cryodeposited frosts of CO2, SO2, and CH3 C1 at temperatures between 12 and 22 degrees K has been investigated both analytically and experimentally. Equilibrium sorption isotherms and the dynamic pumping characteristics of the sorbent, sorbate combination were systematically measured for chamber pressures between ten to the minus seven and ten to the minus four torr. Frost cryosorbents which were formed in a manner to make them more amorphous exhibited greater equilibrium sorption capacities for hydrogen. Carbon dioxide sorbents were formed which were able to sorb one hydrogen molecule for every two predeposited CO2 molecules. It was found that equilibrium sorption isotherms of frost cryosorbents could be predicted by the semi-empirical Dubinin-Radushkevich Equation. A general model of the sorption dynamics was formulated and approximate closed-form solutions were obtained - in the limit of rather compact frost whose sorption behavior would be limited by the ability of the molecules to penetrate and diffuse into the frost, and in the limit of very porous frosts in which the adsorption rate on the frost surface governs the pumping. Theoretical calculations for these limiting cases agreed with the observed pumping characteristics of the more compact and more porous frosts. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N70-39272# Royal Aircraft Establishment, Farnborough (England).
INVESTIGATION OF EXTERNAL SUPERSONIC COMBUSTION [UNTERSUCHUNGEN ZUR AEUSSEREN UEBERSCHALLVERBRENNUNG]
M. Kallergis Feb. 1970 15 p Transl. into ENGLISH from Deut. Forschungsanstalt Luftfahrt e.V., Sep. 1969 p 1–13
(RAE-LIB-TRANS-1453) Avail: NTIS

Experiments were performed on external combustion behind a two-dimensional wedge at a free-stream Mach number of 4. The upper surface of the wedge is parallel to the free stream, and the included angles are 12 deg at the nose and 25 deg at the rear. Fuel is injected just ahead of the expansion corner on the under surface and the resulting shock formation (without ignition) is illustrated by photographs. For the combustion tests, ignition was achieved by preheating the free-stream air in a separate combustion upstream of the model. Author

N70-39315# California Univ., Berkeley.
THE FUTURE OF VEHICULAR POWER PLANTS
Ernest S. Starkman *In* Ariz. Univ. Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 12–52 refs (See N70-39313 22-04)
Avail: NTIS

The automobile is discussed with relation to its comparative role in air pollution, including the pollutants contributed and their effects. Revisions in engine operation to reduce air pollution are mentioned, and it is noted that as the levels of carbon monoxides and unburned hydrocarbons were being lowered, nitrogen oxide levels increased. Federal and state controls are described, and future air quality is predicted. The slow rate at which pollution control can be realized through the modification of new vehicles alone is suggested. Powerplants possible for automobiles other than internal combustion engines are described, including the electric vehicle and associated problems, steam engines, gas turbines, Wankel and Stirling engines, and engines using natural gas as fuel. Accomplishments in pollution reduction due to conventional engine controls are discussed, and past and future relative pollutant production from automobiles is compared with that from stationary sources. Graphs illustrate the presentation, and a bibliography is included. P.A.B.

N70-39415*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLANETARY EXPLORATION SRT: ADVANCED TECHNICAL DEVELOPMENT
In its Res. and Advanced Develop. 31 Aug. 1970 p 43–209 (See N70-39411 22-34)
Avail: NTIS CSCL 21H

The trade off between specific impulse and solid propellant motor mass fraction for propulsion requirements needed in outer planet orbit insertion motors is determined. Considered is a low acceleration motor containing beryllium ized propellant combined with a hydrazine monopropellant vernier engine for the baseline propulsion system in the Jupiter Orbiter study. The results of the solid/mono option will be included in the Jupiter Orbiter design study report. Author

N70-39421*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF DYNAMIC VARIATIONS IN ENGINE-INLET PRESSURE ON THE COMPRESSOR SYSTEM OF A TWIN-SPOOL TURBOFAN ENGINE
John E. McAulay Washington Sep. 1970 33 p refs
(NASA-TM-X-2081; E-5618) Avail: NTIS CSCL 21E

The effects of spatially uniform and distorted dynamic engine-inlet pressure variations between 1 and 80 Hz on the compressor system of a twin-spool turbofan engine are presented. The inlet pressure variations were produced by rapid changes in secondary airflow injected as many small contrastream jets ahead of the engine. Compressor system stall was encountered with both spatially uniform and distorted dynamic variations in inlet pressure. The factors which induced compressor stall were found to be the magnitude of instantaneous distortion, rate and magnitude of change of inlet pressure, and dwell-time of the fan-compressor rotor blading in the low-pressure region of an engine-inlet distortion. Author

N70-39613*# General Dynamics/Convair, San Diego, Calif.
CRYOGENIC PROPELLANT ACQUISITION AND TRANSFER
R. E. Tatro *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 167–187 (See N70-39603 22-31)
Avail: NTIS CSCL 21H

The technologies required to successfully design acquisition and transfer systems for the shuttle are in the areas of storage tank fluid dynamics and thermal conditioning, pressurization and pumping system interfaces, and receiver tank thermodynamics. Comparing bladders, diaphragms, bellows, linear acceleration, dielectrophoresis, and capillary devices for propellant acquisition indicates the selection of capillary devices based on versatility, reusability and weight. Considerations in design of a cryogenic acquisition system are fluid dynamics, thermal conditioning, and fabrication. Pressurization and pumping considerations involve prevention of tank pressure decay, feedline conditioning, and pump transient tradeoffs. Transfer line and receiver tank considerations involve configurations, and flow rates based on thermal conditioning, chilldown, geysering, and venting requirements. Conclusions are that present studies are adequate to satisfy preliminary design requirements. Author

N70-39614*# North American Rockwell Corp., Downey, Calif.
CRYOGENIC SYSTEMS HARDWARE TECHNOLOGY REVIEW FOR THE SPACE SHUTTLE
Dieter K. Huzel *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 189–201 (See N70-39603 22-31)
Avail: NTIS CSCL 21H

This evaluation concerns itself with the hardware required for shuttle cryogenic systems. It will be postulated that certain of the current – mainly Saturn V – designs and design concepts appear to be basically suitable to fill some of the needs, while for others potentially serious technology voids may exist. To remedy the latter, effective utilization of available lead time is urged, and recommendations are presented. Author

N70-39615*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
CRYOGENIC SYSTEMS INTEGRATION TECHNOLOGY FOR THE SPACE SHUTTLE
J. D. Schweikle *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 203–214 (See N70-39603 22-31)
Avail: NTIS CSCL 21H

The resolution of identified technologies in long term cryogenic storage with a reusable insulation system and operation of a propellant orientation system in a zero g environment will satisfy the desire to integrate the long term storage systems on the space shuttle. This degree of integration will reduce launch preparations and vehicle complexity, enhance maintainability, and will provide mission flexibility. The integration by storage time does not penalize the orbital systems. The additional complications to already tough technology problems associated with integration of the orbital propellant in the large boost tanks can be eliminated. Author

N70-39616*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE SHUTTLE CRYOGENIC TECHNOLOGY REVIEW
Charles C. Wood *In its* Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 215 (See N70-39803 22-31)
Avail: NTIS

The Saturn V, Centaur and technology programs have provided an excellent base for space shuttle cryogen system design. Although technology advancements are required to support the space shuttle development, no major technology breakthroughs are required. However, limited or immature background data preclude baselining at this time the most desirable approaches in the areas of propellant acquisition, propellant transfer, propellant mass gauging in orbit, insulation and various hardware aspects. Author

N70-39627*# Aerojet Liquid Rocket Co., Sacramento, Calif.
TECHNOLOGY CONSIDERATIONS FOR MAIN ENGINE SPECIFIC IMPULSE
D. L. Kors *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 27–55 refs (See N70-39626 22-31)
Avail: NTIS CSCL 21H

Four major technology areas which influence main engine specific impulse are discussed. This includes a description of the techniques which are available for achieving success in each of these areas and some of the limitations of the techniques. A brief summary for each of the following areas is given: (1) analytical and experimental techniques for satisfying high combustion performance criteria; (2) regenerative cooling process design; (3) computer analysis for optimal nozzle design parameters on engine delivered impulse; and (4) computer program for estimating specific impulse predictions. Author

N70-39628*# Pratt and Whitney Aircraft, West Palm Beach, Fla.
TECHNOLOGY FOR SPACE SHUTTLE MAIN ENGINE CONTROL CHECKOUT AND DIAGNOSIS (GP 70-232)
L. D. Emerson and B. C. Miller *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 57–89 refs (See N70-39626 22-31)
Avail: NTIS CSCL 21H

The space shuttle main engine (SSME) performance and weight requirements are best met by a staged combustion cycle. Because a high performance light weight engine must operate close to component physical limits, control of critical engine parameters must be maintained during steady-state and transient conditions. A control system is therefore required to provide both engine protection and overall thrust and mixture ratio precision. Based on considerations of precision, environment, and compatibility with vehicle interface commands, an electronic engine control unit appears to be best suited to the SSME design. Use of an electronic control makes available many functions that logically provide the information required for engine system checkout and diagnosis. Author

N70-39629*# Rocketdyne, Canoga Park, Calif.
REGENERATIVE COOLING OF THE SPACE SHUTTLE ENGINE
Henry C. Wieseneck *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 90–120 (See N70-39626 22-31)
Avail: NTIS CSCL 21H

The space shuttle engine imposes requirements on regenerative cooling well beyond those associated with current engine systems. This presentation will compare those requirements to capabilities and available technology of regenerative cooling. Author

N70-39630*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TECHNOLOGY ISSUES FOR SHUTTLE MAIN ENGINE: STAGE INTEGRATION
A. L. Worlund, T. W. Winstead, and W. B. Mc Anelly *In its* Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 122–143 refs (See N70-39626 22-31)
Avail: NTIS CSCL 21H

The high performance objectives and cost effective development goals of the shuttle main engine are enhanced by early consideration of engine-stage integration requirements. The propellant thermal conditioning required to suppress feedline geysers can also provide orbiter propellant quality control at booster-orbiter staging. This capability could reduce engine development cost. Early analytical and experimental consideration of the engine-feedline transient response will preclude incompatibility of the engine control system and the vehicle feedlines and will minimize the potential for longitudinal vehicle instability. The application of existing base heating data to the shuttle is limited. Therefore, technology tasks are required to develop adequate models of the base thermal environment and to establish design criteria for engine and stage components. Author

N70-39631*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE SHUTTLE REACTION CONTROL SYSTEM REQUIREMENTS
Henry O. Pohl *In its* Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 145–161 (See N70-39626 22-31)
Avail: NTIS CSCL 21H

The optimum reaction control system is the one which will provide adequate overall performance and simultaneously result in the maximum vehicle payload capability. This requirement is in most cases satisfied by the subsystems concepts (injection propulsion, orbit maneuvering propulsion, rcs, etc.) which collectively result in the lowest total vehicle weight. This paper not only deals with the tangible shuttle vehicle rcs requirements which have already been identified over the past year (such as accelerations, total impulse, thrust levels, etc.), but addresses itself, as well, to the advantages of somewhat intangible requirements which are not readily apparent to the uninitiated observer. Author

N70-39632*# McDonnell-Douglas Co., St. Louis, Mo.
LOW PRESSURE OXYGEN-HYDROGEN AUXILIARY PROPULSION SUBSYSTEMS
Lloyd F. Kohrs *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 163–188 (See N70-39626 22-31)
Avail: NTIS CSCL 21H

A prime candidate for the auxiliary propulsion subsystem of the space shuttle vehicle is the low pressure concept which takes advantage of the main boost tank as an accumulator, a heat exchanger, and a source of propellant. Definition of the low pressure system suitable for the orbiter and booster is the subject of a contracted effort. In addition, this APS concept will be considered as a task in the phase b vehicle definition program. Presented are the results of analysis that have been conducted on the subsystem discussing alternative methods of operation and the technology requirements for some of the components and assemblies which make up the subsystem. Author

N70-39633*# TRW Systems Group, Redondo Beach, Calif.
SPACE SHUTTLE HIGH PRESSURE AUXILIARY PROPULSION SYSTEM
H. L. Burge, J. Cuffe, and A. Shaffer (AiResearch Mfg. Co., Los Angeles) *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 189–223 Prepared in cooperation with AiResearch Mfg. Co., Los Angeles (See N70-39626 22-31)
Avail: NTIS CSCL 21H

The requirements for a high pressure space shuttle auxiliary propulsion system are reviewed. For a defined vehicle and mission, these are determined by the primary propulsion system capability. Some of the fundamental system problems are discussed and the influence of auxiliary propulsion system delta requirements upon the system performance sensitivity is determined. The main elements of a high pressure auxiliary propulsion system are defined. Technology efforts are divided into three overlapping and interacting activities, namely fundamental limits, application limits and predevelopment activities. To illustrate some of the problems discussed in this paper, a candidate high pressure auxiliary propulsion system for high delta applications is presented and discussed. Author

N70-39634*# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany).
TECHNOLOGY FOR THE DEVELOPMENT OF A GASEOUS HYDROGEN-GASEOUS APS ENGINE FOR THE SPACE SHUTTLE
Albert Seidel *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 225–250 (See N70-39626 22-31)
Avail: NTIS CSCL 21H

Experience and technological capability to produce thrust chambers of various designs, injector heads and engine valves, and the capability to test them can be utilized for the development of a space shuttle auxiliary propulsion system engine. A vacuum-thrust LH2/LF2 1,100 lb engine falls into the presently discussed performance category. Using the same chamber geometry of the 1,100-lb engine, running it with GH2/GO2 at a chamber pressure of 150 psia and at a mixture ratio of 4, it would produce a vacuum thrust of 1,500 lbs with an area-ratio-30 nozzle. With constant engine geometry and varying chamber pressure it can also be adjusted to other thrust levels within a wide range. Currently a sea-level demonstration engine of this type is under development in order to demonstrate its ability of safe ignition, regenerative cooling and high performance. Author

N70-39635*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE SHUTTLE AUXILIARY PROPULSION TECHNOLOGY REQUIREMENTS
Keith D. Coates *In its* Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 251–264 (See N70-39626 22-31)
Avail: NTIS CSCL 21H

After a review of the anticipated most critical areas required for design of an auxiliary propulsion system for the space shuttle, the conclusion is that existing technology is not adequate; new technology is required regardless of the choice of a high or low pressure auxiliary propulsion system. However, with the existing O2/H2 propulsion systems base and with the required time and funds made available, the areas of concern only represent interesting engineering problems and not impossible dreams. Author

N70-39636*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE SHUTTLE AUXILIARY PROPULSION TECHNOLOGY PLANS
Donald L. Nored *In its* Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p265–290 (See N70-39626 22-31)
Avail: NTIS CSCL 21H

Auxiliary propulsion for the space shuttle has been identified as a critical technology area. Requirements for long system life, reusability, minimal checkout and maintenance, and high performance are unique and critical to the space shuttle concept. The technology base for auxiliary propulsion systems utilizing gaseous hydrogen and gaseous oxygen, the selected propellants, is very limited, however, and a major extension to current state-of-the-art will be needed to meet such requirements. In addition, consideration of translational propulsion will impose an added complexity. Author

N70-39637*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENGINE DESIGN AND TECHNOLOGY REQUIREMENTS (PANEL DISCUSSION)
In its Space Transportation System Technol. Symp., Vol. 4 Jul. 1970 p 291–378 (See N70-39626 22-31)
Avail: NTIS CSCL 21H

Reviewed are some of the mission and environmental requirements facing the airbreathing engines for the space shuttle. Many of these requirements are new for gas turbine engines. These include the hydrogen fuel system and exposure to launch, reentry, and space environments. Engine design studies being conducted have the primary purpose of determining engine features and modifications required for the shuttle mission. Engines typical of those being considered for the shuttle vehicles will be selected for these design studies. The steady-state and transient operation of a hydrogen fuel system will be studied by analyzing, fabricating and testing such a system using an existing engine as a test bed. The purpose of the technology studies is to provide a sound basis for the development of the airbreathing propulsion system for the shuttle. Author

N70-39647*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CHEMICAL PROPULSION
In its Res. and Advanced Develop., Vol. 2 15 Feb. 1970 p 469–550 refs (See N70-39642 22-34)
Copyright. Avail: NTIS HC$10.00/MF$0.65 CSCL 21I

Advances in liquid and solid rocket propulsion technology are reported. The studies include propellant combustion behavior, mixing, nozzle flow, and performance prediction. R.B.

N70-39648*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CHEMICAL ROCKET EXPERIMENTAL ENGINEERING
In its Res. and Advanced Develop., Vol. 2 15 Feb. 1970 p 551–596 (See N70-39642 22-34)
Copyright. Avail: NTIS HC$10.00/MF$0.65 CSCL 21H

The technology of liquid propulsion components for future space missions is considered. Emphasis is placed on space-storable components, although earth-storable components are considered for specific requirements. The technology and test methods for solid propulsion and auxiliary systems are also discussed. R.B.

N70-39895* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTISTAGE MULTIPLE-REENTRY TURBINE Patent
Warner L. Stewart and David G. Evans, inventors (to NASA) Issued 25 Dec. 1962 (Filed 27 Apr. 1960) 7 p Cl. 253-68
(NASA-Case-XLE-00085; US-Patent-3,070,349; US-Patent-Appl-SN-25175) Avail: US Patent Office CSCL 21E

A multistage axial flow turbine is described as being relatively small in size and low in weight, and as having a low rotating mass, comparatively low rotor blade operating temperatures for a given turbine-inlet temperature, high rotor blade heights and high rotative acceleration. The turbine consists of a single rotor having a plurality of blades circumferentially placed around the periphery of the rotor. An inlet duct is provided which directs the incoming fluid to one side of the rotor blades and serves to keep a supply of fluid within the turbine. A reentry duct is also provided to receive the outlet stream after the fluid passes across the rotor blades and to conduct the fluid back to the opposite side of the rotor blades. A plurality of reentry ducts may be utilized; the process of reentry is repeated continually until all of the work of the incoming fluid is expended. The particular application described is a three stage turbine, with two reentry ducts comprising the second stage and three ducts comprising the third stage. P.A.B.

N70-39899* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TELESCOPING-SPIKE SUPERSONIC INLET FOR AIRCRAFT ENGINES Patent
James F. Connors, inventor (to NASA) Issued 11 Dec. 1962 (Filed 27 Feb. 1958) 4 p Cl. 60-35.6
(NASA-Case-XLE-00005; US-Patent-3,067,573; US-Patent-Appl-SN-718095) Avail: US Patent Office CSCL 21E

An aircraft engine inlet with high diffuser efficiencies over a large range of Mach numbers and essentially zero cowl drag is described. The nozzle approximates the theoretical contour required for isentropic compression and provides a subsonic dump or abrupt area of discontinuity downstream of the throat. The inlet has an axially movable cowl, and a compression spike mounted concentrically and with tapered sections which telescope into a conical contoured surface. N.E.N.

N70-39925* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH TEMPERATURE SPARK PLUG Patent
John E. Watson, inventor (to NASA) Issued 11 Jan. 1966 (Filed 18 Oct. 1962) 4 p Cl. 313-11.5
(NASA-Case-XLE-00660; US-Patent-3,229,139; US-Patent-Appl-SN-231604) Avail: US Patent Office CSCL 21B

An ignitor plug for operation at high temperature with a life expectancy of hours or days is described. The plug has no metallic parts exposed to flame impingement. The annular electrode is made of graphite rigidly mounted at the base of the plug and is capable of withstanding a temperature in excess of 7000 F. It shields the exposed portion of the center electrode and the ceramic insulator while enabling the ignitor plug to produce the spark required for igniting the liquid rocket propellant. N.E.N.

N70-39931* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRAJECTORY-CORRECTION PROPULSION SYSTEM Patent
William W. Smith and Bruce W. Schmitz, inventors (to NASA) Issued 18 Jan. 1966 (Filed 26 Jun. 1963) 7 p Cl. 60-39.48
Sponsored by NASA
(NASA-Case-XNP-01104; US-Patent-3,229,463; US-Patent-Appl-SN-290867) Avail: US Patent Office CSCL 21H

The trajectory correction propulsion system described is capable of multiple space starts and of extended storage in a space environment. The system has feed means for the propellant and catalyst which assure that ignition occurs only when intended, in order to eliminate malfunction hazards. A ratchet-type propellant valve oxidizer start slug device allows positive displacement of a predetermined quantity of oxidizer in a zero gravity field upon each opening actuation of the propellant valve. The rocket engine is characterized by relatively light weight, small size, reusability, and suitability for varied sizes and classes of vehicles. P.A.B.

N70-39949# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BIRTH OF A SPACE ENGINE
V. Kislov 8 Apr. 1970 10 p Transl. into ENGLISH from Trud (Moscow), 5 Feb. 1970 p 1–5
(AD-708333; FTD-HT-23-201-70) Avail: NTIS CSCL 21/8

The Reporter relates his impressions of a plant that manufactures rocket motors for space vehicles. The following departments of the plant are mentioned: Department of Reliability, Strength Laboratory, Department of Design, and also the office of the Chief Designer. The plant manufactures and tests liquid rocket motors for various space vehicles. Two motors, the sustainer motor and back-up counterpart, are mounted on the Soyuz ships. A Soyuz ship can carry on maneuvers up to an altitude of 1,300 KM, depending upon the fuel. The nozzles of space rocket motors are cooled by the propellent before it enters the combustion chamber. The motors are tested for performance time which is ten times as long as the actual one. The exhaust colors of a test motor are described as cherry red, reddish-yellow, pink and brightly white with a bluish hue - in that order. The author concludes with the statement that "A liquid rocket motor will serve man in space explorations for some time to come." Author (TAB)

N70-40023# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
COMPUTER OPTIMIZATION OF WATER-AUGMENTED TURBOFAN CONCEPT AND DEVELOPMENT OF A TEST FACILITY FOR TWO-PHASE FLOW
Randolph Grant Watson Jun. 1969 110 p refs
(AD-708044) Avail: NTIS CSCL 13/10

A turbofan engine propulsion system in which large amounts of water are injected into the fan discharge duct is investigated with the goal of increasing both the thrust and propulsive efficiency while retaining the light-weight qualities of a standard turbofan engine. A parametric computer analysis is used to examine the effect of several variables, including water-to-gas generator air ratio, water injection velocity, fan duct pressure loss, and fan duct thermal and dynamic nonequilibrium, upon thrust and propulsive efficiency. In addition, the design parameters of fan pressure ratio and fan bypass ratio are examined for their optimum values, and optimum operating combinations of water-to-gas ratio and water injection velocity are determined. A test apparatus is developed for the direct measurement of wall friction force in two-phase flows.

A computer program is presented to reduce experimental data and compare with pressure drop predicted by two empirical correlations. Author (TAB)

N70-40364# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF THE PRODUCTION OF LIQUID-PROPELLANT ROCKET ENGINES
I. I. Gorev 30 Apr. 1970 422 p refs Transl. into ENGLISH of the publ. 'Osnovy Proizvodstva Zhidkostnykh Raketnykh Dvigateley' Moscow, Izd-Vo 'Mashinostr.', 1969 p 1-356
(AD-708443; FTD-MT-24-39-70) Avail: NTIS CSCL 21/8.1

The book examines the technological processes of the manufacture of the most characteristic parts, subassemblies and units of liquid-propellant rocket engines. These include the combustion chamber, turbopump unit, power frames, valves, pipelines and also the technology of unit and general assembly. Contemporary methods of the obtaining of accurate thin-walled large parts, the technology of their machining and the adaptation for the fastening of parts having little rigidity are discussed. Methods are examined for connecting thin-walled large parts by welding and brazing with the use of high-temperature solders as well as the design of special devices for welding and soldering in inert gases and a vacuum. Characteristic defects of welding and soldering and methods of detecting them are given. The technology of the manufacture of injectors, injector heads and the assembly of combustion chambers are examined. Methods of the manufacture of thin-walled pipelines of complex configuration from sheet metal, the technology of the fitting nipples, formation of corrugations, and methods of the assembly of pipelines are discussed. Methods of static and dynamic balancing of parts and subassemblies of the turbopump unit are examined. Author (TAB)

N70-40367* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR CONTINUOUS VARIATION OF PROPELLANT FLOW AND THRUST IN PROPULSIVE DEVICES Patent
Gerald Morrell, inventor (to NASA) Issued 24 Jul. 1962 (Filed 24 Feb. 1960) 5 p Cl. 60-35.3
(NASA-Case-XLE-00177; US-Patent-3,045-424; US-Patent-Appl-SN-10812) Avail: US Patent Office CSCL 21H

A method is described for thrust variation of propellant propulsive devices by modulation of the propellant flow through density control. The flow theory of liquid foams is applied to the rocket engine injection process. By applying the foam-flow theory to the injector orifice of a rocket engine, the reduction in propellant flow is a function of the ratio of the flow rates of the inert gas and the propellant. The rate of propellant flow through the injector orifice decreases as the foaming of the incoming propellant stream is increased. By varying the inert gas flow, the flow rate of the propellant through the orifice can be varied. R.B.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N70-39019# Directorate of Scientific Information Services, Ottawa (Ontario).
FORECAST OF THE MAXIMUM WOLF NUMBER FOR THE CURRENT ELEVEN-YEAR CYCLE
A. I. Ol May 1970 4 p refs Transl. into ENGLISH from Probl. Arktiki i Antarktiki (USSR), issue no. 28, 1968 p 137-139
Avail: NTIS

A modified method of calculating the Wolf number for the even numbered 11-year cycles of the 22-year cycle is presented. A parameter q is introduced which is the mean value of the difference between the minimum of the magnetic activity and the Wolf number of the decreasing 11-year cycle. Using a value of q for the falling branch of cycle No. 19, a value of 95+ or − 15 for the maximum Wolf number for cycle No. 20 is obtained. Other determinations of the Wolf number are briefly discussed, and it is concluded that the present value is in fairly good agreement with the majority of estimates. N.E.N.

N70-39020# Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia).
ULTRAVIOLET RADIATION
B. G. Collins 25 Jun. 1970 4 p refs *Its* Radiation Circ. No. 7
Avail: NTIS

Global ultraviolet radiation measurements were taken with Kipp pyranometers with hemispherical Schott glass filters. Graphs of the filter transmissivity, direct solar ultraviolet irradiance, and mean transmissivity versus air mass are presented. N.E.N.

N70-39078 Colorado State Univ., Fort Collins.
ELECTROMAGNETIC INTERACTIONS OF HIGH ENERGY COSMIC RAY MUONS
Walter Robert Binns (Ph.D. Thesis) 1969 93 p
Avail: Univ. Microfilms: $4.80/Microfilm $3.00 Order No. 69-17060

A Wilson multiplate cloud chamber was operated underground at a depth of 274 MWe to measure the muon knock-on and direct pair cross sections in lead and iron. Approximately 18,000 photographs of muon traversals were accepted as data. For about half of the traversals, the chamber contained 19 lead plates 1/8 inch thick. For the remainder of the experiment, the chamber contained 19 iron plates 3/16 inch thick. The underground muon spectrum was calculated by first obtaining the surface muon spectrum at the mine location, and experimentally verified energy loss relationships were than applied to obtain the underground muon spectrum. The theoretical values for the muon knock-on electron cross section were calculated from the Bhabha formula. The theoretical results of Murota, Ueda, and Tanaka were used to obtain the predicted direct pair cross section. The underground muon spectrum was then folded into the theoretical cross section to obtain the predicted number of events. Dissert. Abstr.

N70-39187 Rice Univ., Houston, Tex.
HIGH LATITUDE IONIZATION SPIKES OBSERVED BY THE POGO ION CHAMBER EXPERIMENT
James Ernest McCoy (Ph.D. Thesis) 1969 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-19315

Data were reduced and organized in the form of ionization plots vs invariant latitude for individual orbits during the period October 14, 1965 to April 1, 1966. Ionization spikes appearing occasionally on these plots at high latitudes were studied in detail. It is shown that these spikes are present near the high latitude boundary of stably trapped radiation on at least 30% of the satellite passes through this region. The occurrence of those spikes lying just inside the observed boundary of trapping appears to be evenly distributed with respect to local time, while the occurrence of spikes at latitudes outside the region of stable trapping is predominantly in the dawn hemisphere. The frequency of occurrence of all spikes increases markedly with increased magnetic disturbance. The dynamics of expected charged particle motion near the boundary of trapping are examined on the basis of a magnetosphere model. Dissert. Abstr.

N70-39306*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TOTAL ELECTRON CONTENT MEASUREMENT WITH A GEOSTATIONARY SATELLITE DURING THE SOLAR

ECLIPSE OF 7 MARCH 1970

S. Rangaswamy (NAS) and P. E. Schmid Aug. 1970 21 p refs Presented at the Upper Atmospheric Currents and Elec. Fields Symp., Boulder, Colo., 17–21 Aug. 1970

(NASA-TM-X-65330; X-551-70-322) Avail: NTIS CSCL 04A

Reported is the measurement of the total electron content of the ionosphere at the Goddard Space Flight Center, looking towards the geostationary satellite ATS-3 during the solar eclipse of March 7, 1970. Obscuration at this site was near total. Faraday rotation was measured using a stationary circularly polarized antenna and a dual channel phase lock receiver tuned to 137.350 MHz. By comparing the electrical phase of the two opposite circularly polarized components a continuous chart recording was made of Faraday rotation versus local time. A depletion of about 25% in electron content was observed from first contact to the time of minimum electron content. The time variations of the electron content during the eclipse are briefly examined in the light of current theories of ionospheric processes. Author

N70-39454# Naval Research Lab., Washington, D.C. Hulburt (E. O.) Center for Space Research.

THE SOLAR CYCLE VARIATION OF SOFT X-RAY EMISSION

R. W. Kreplin *in its* Rept. of NRL Progr. Feb. 1970 p 8–17 refs (See N70-39452 22-34)

Avail: NTIS

X-ray monitoring of the sun by the NRL Solrad satellites has provided nearly continuous records from which the daily average solar X-ray emission levels in the bands 44 to 60 angstroms, 8 to 20 angstroms, and 1 to 8 angstroms have been obtained since January 1964. These records show increases of a factor of 20 in the 44 to 60 angstrom band between solar minimum in 1964 and solar maximum in 1969. For the same period an increase of a factor of 200 was observed in the 8 to 20 angstrom band. Short-term fluctuations of solar X-ray emissions are observed to correspond to the presence of active sunspot regions on the disk. A detailed examination of the X-ray history of one such region, McMath 8207, shows that the emission levels vary with complexity of the magnetic fields of the spot group. Observation of X-ray emissions 1-1/2 days prior to the appearance of the active region on the limb indicates emission from altitudes as great as 50,000 kilometers in the lower corona. Author

N70-39503# Technische Hochschule Aachen (West Germany). Physikalisches Inst.

SEARCH FOR FRACTIONALLY CHARGED PARTICLES IN SHOWERS

H. Faissner, M. Holder, K. Krisor, G. Mason, Z. Sawaf et al 1970 13 p refs Supported in part by Landsamt fuer Forsch. des Landes Nordhein-Westfalen

(PITHA-36) Avail: AEC Depository Libraries

A search was made for relativistic quarks of charge e/3 in cosmic ray showers at sea level. A hodoscope of wire proportional counters was used, which was capable of measuring the location and specific ionization of several particles arriving simultaneously. An upper limit for the flux of quarks observed singly in the apparatus was established with 90% confidence. Corresponding limits were set for quarks with one and two accompanying particles. Author (NSA)

N70-39828*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A SOLAR X RAY ASTRONOMY SUMMARY AND BIBLIOGRAPHY

Robert M. Wilson, John M. Reynolds, and Stanley A. Fields Jan. 1970 143 p refs

(NASA-TM-X-53991) Avail: NTIS CSCL 03B

A review of solar X-ray astronomy is given with tables summarizing some of the results of the survey. A list of observed solar spectral lines and a tabulation of all X-ray flight experiments from the literature surveyed are provided. The bibliography is annotated and cross-referenced. Author

N70-39995# American Science and Engineering, Inc., Cambridge, Mass.

ANALYSIS OF SATELLITE DATA, 1 APRIL 1969–31 MARCH 1970

Daniel R. Parsignault and Richard C. Chase 31 Mar. 1970 103 p refs

(Contract F19628-67-C-0277)

(AD-707645; ASE-2400; AFCRL-70-0254) Avail: NTIS CSCL 4/1

Results of the analysis of some data obtained from the polar orbiting Satellite OV1-9 (1968 - 111A) and OV1-13 (1968 - 26A) are presented. The data analysis pertains to (a) electron data with $E > 0.94$ MeV, in the outer radiation belt (OV1-9), (b) electron and proton data with $10 < E < 50$ KeV, in the inner and outer radiation belts (OV1-13). Author (TAB)

N70-40154*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE FLUCTUATION OF COSMIC RAY ANISOTROPY AND THE DIMENSIONALITY OF PROPAGATION

Frank C. Jones Sep. 1970 8 p refs Submitted for publication

(NASA-TM-X-65336; X-641-70-348) Avail: NTIS CSCL 20H

The relationship between the dimensionality of the cosmic ray propagation function and the statistical distribution of anisotropies is demonstrated and an argument is presented in favor of essentially one dimensional propagation. This implies that a fluctuation explanation of low observed anisotropy can not be ruled out as has been stated by previous authors. Author

N70-40313# Manila Observatory (Philippines).

SOLAR RADIO STUDIES AT MANILA OBSERVATORY Final Report, 15 May 1967–14 May 1970

Victor L. Badillo 30 May 1970 28 p refs

(Contract F19628-67-C-0300)

(AD-708723; AFCRL-70-0358) Avail: NTIS CSCL 3/2

The report summarizes the work performed at Manila Observatory in the period 1967 to 1970, the peak of solar cycle 20. A solar radio patrol was maintained with six single frequency radiometers (8800, 4995, 2695, 1415, 606 and 245 MHz) and a 24-48 MHz swept frequency interferometer radiometer. During this active period ten proton flares were recorded and detailed radio-optical studies made of some of them. The latest proton flare, 29 March 1970, is discussed here. A list and abstracts of publications or completed papers is provided in the Appendix. Author (TAB)

N70-40351# Lockheed Missiles and Space Co., Palo Alto, Calif.

INVESTIGATION OF COSMIC RAYS AND THE RADIATION BELTS WITH A VERTICAL SPACE PROBE

S. N. Vernov et al [1970] 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 8, no. 3, 1970 p 408–417

Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results are presented of processing data from a vertical space probe launched 12 October 1967. The altitude behavior of cosmic rays on the magnetic shells $1.7 < L < 2.2$ was obtained; the multiplication coefficient of cosmic rays was determined for a counter on the surface of an object, and the sharp anisotropy of the flux of cosmic ray albedo was noted. The electron spectrum at the magnetic shells $2 < L < 3$ was measured in the earth's radiation belts. The pitch-angle distribution of electrons with energy greater than 40 keV was studied on the magnetic shells L = 2.2, 2.6, 3.0, and an increase in the fluxes of electrons being poured out was detected as L increases. Author

N70-40363# Lockheed Missiles and Space Co., Palo Alto, Calif.
PROTON AURORAE AND 'RESONANCE' CONCEPTION OF A SUBSTORM
Iu. I. Galperin et al [1970] 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 8, no. 3, 1970 p 457–460
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Proton aurora studies based on the glow of the hydrogen emission of the aurorae are reviewed, along with Cosmos 261 measurements. Refinements of the theory of hydrogen emission allowing better agreement between spectroscopic profile measurements and direct auroral proton measurements are discussed. The motion of quasi-captured medium energy particles in the magnetosphere is examined. The deduction is made that the characteristic particle energy of approximately 10 kev which is accepted for the quasi-captured component of auroral protons, for the energy beyond which the electron spectrum drops sharply, and for particles of a quiet ring current at L approximately 6, is due to the resonance of the longitudinal drift for such energies in the magnetosphere. Based on this discussion, a resonance conception for the origin of substorms is proposed. P.A.B.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N70-39056# Directorate of Scientific Information Services, Ottawa (Ontario).
SOME NOTIONS RE THE AEROSOL COMPONENT OF THE MARTIAN ATMOSPHERE AND THE COLOR OF MARS AS RESULTING FROM THE OPTICAL PROPERTIES OF THE PLANET'S ATMOSPHERE
N. N. Sytinskaya et al May 1970 4 p Transl. into ENGLISH from the book "Voprosy Astrofiziki" Kiev, Naukova Dumka, 1965 p 79–81, 91–92
Avail: NTIS

The presence of suspended particles in a gas has little effect on the mass and density, but greatly increases the scattering capacity of the medium. Therefore in the case of photometrically obtained values for mass, density and pressure of the Martian atmosphere at the surface of the planet it is necessary to separate the gas and aerosol components of the atmospheric brightness. Since no sufficiently reliable methods were proposed for doing this, it is interesting to reverse the problem and, using the pressure values determined by other methods, to study photometrically the content of suspended particles. Author

N70-39106 Michigan Univ., Ann Arbor.
A SEARCH FOR METAL-DEFICIENT STARS
Howard Emerson Bond (Ph.D. Thesis) 1969 177 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-17969

Four-color Stromgren photoelectric photometry was obtained for over 250 suspected metal-deficient stars found on the objective-prism plates. Among the newly discovered metal-deficient stars are several interesting very metal-poor giants, subdwarfs, red giants similar to those in the globular clusters, stars probably showing evidence of nucleosynthesis in their interiors, and a group of early F-type metal-poor dwarfs. The space motions of metal-deficient stars selected on the basis of their spectra are much lower than for those discovered as a consequence of their large proper motions. Among the stars with more than one-tenth the metal content of the sun, there appears to be little or no correlation between kinematics and chemical composition. Dissert. Abstr.

N70-39132 California Univ., Berkeley.
VARIABILITY NEAR THE INSTABILITY STRIP IN THE DELTA SCUTI REGION
Michel Breger (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-18884

More than 200 bright field stars were tested photoelectrically for short-period variability. Nineteen variables and one suspended variable were found. At least sixteen of these are delta Scuti variables. Narrow-band photometric and spectroscopic data have been collected for these survey as well as other delta Scuti stars. New absolute magnitudes were calculated. Data on all stars inside the instability considered to be either variable or nonvariable have been collected. The role of luminosity, temperature, metal abundance, binary characteristics and rotational velocity in determining the incidence and amplitude of pulsation as well as the possible period have been discussed. A period - luminosity - color relation has been established for the delta Scuti variables. Dissert. Abstr.

N70-39239 Stanford Univ., Calif.
HIGH RESOLUTION STUDIES OF SOLAR MICROWAVE RADIATION
Anthony Copper Riddle (Ph.D. Thesis) 1969 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-14009

New results are presented from a study of radiation at a wavelength of 9.1 cm as observed during the quiet sun years, 1964 to 1965, using the Stanford spectroheliograph. A map of the quiet sun has been prepared and compared with a map produced in 1960 using the same instrument. On the basis of ray tracing results the differences in the two maps can be explained by a decrease in the electron density by a factor of 1.4 at the equator and 1.1 at the poles. The slowly varying component of the emission can be attributed to electron density enhancements by a factor of 2 to 5 over regions with dimension 2 to 6 min arc which are associated with plage and sun spot regions seen optically. Under the assumption that the microwave emission originates radially above the associated optical feature the height of the microwave emission region above the photosphere can be calculated. Dissert. Abstr.

N70-39247 Colorado Univ., Denver.
RECOMBINATION SPECTRA FROM PLANETARY NEBULAE
David Joshua Van Blerkom (Ph.D. Thesis) 1969 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-19576

The radiative flux from the central star of a planetary nebula is either ignored or approximated by a black body function over its entire spectrum. Because observations of some planetary nebulae have indicated large deviations from recombination theory of the relative intensities of lines in the visible series of H, He 1 and He 2, a more accurate treatment of the transfer problem is presented. The multilevel transfer problem in the Lyman lines and continuum is shown to be equivalent to a set of coupled two-level problems. Each two-level problem is solved by means of the normalized on-the-spot approximation, which is found to give accurate results for photons which have a high probability of destruction or escape per scattering. The given techniques permit the determination of the recombination line spectrum from nebulae of arbitrary optical thicknesses and excited by central stars radiating in any prescribed manner. Dissert. Abstr.

N70-39276*# National Aeronautics and Space Administration, Washington, D.C.
PROCEEDINGS OF THE SEVENTH ANNUAL WORKING GROUP ON EXTRATERRESTRIAL RESOURCES
1970 148 p refs Conf. held at Denver, 17–18 Jul. 1969 (NASA-SP-229) Avail: SOD $1.50; NTIS CSCL 22A

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8. A MANNED LUNAR MISSION FOR WATER EXPLORATION IN THE MARIUS HILLS J. S. Choate, C. D. Mosbruger, V. M. Kemp, S. W. Johnson, and T. R. McGetchin (Air Force Inst. of Tech.) p 75–86 refs (See N70-39284 22-30)

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10. VACUUM ADHESION AND ITS LUNAR MINING IMPLICATIONS P. Blum and M. J. Hordon (Norton Res. Corp.) p 93–99 refs (See N70-39286 22-15)

11. A STUDY OF FRICTION AND ADHESION IN A SIMULATED LUNAR VACUUM S. A. Fields (NASA, Marshall Space Flight Center) p 101–105 refs (See N70-39287 22-30)

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13. COMMENTS ON LUNAR SURFACE ADHESION J. A. Ryan and J. J. Grossman (McDonnell-Douglas Astronaut. Co., Santa Monica, Calif.) p 113–115 refs (See N70-39289 22-30)

14. EXPLOSIVES AND THE LUNAR ENVIRONMENT R. M. Cox, Jr. (Ala. Univ., Univ.) p 117–118 refs (See N70-39290 22-30)

15. EARLY WATER MINING ON THE MOON R. O. Shotts (Ala. Univ., Univ.) p 119–129 refs (See N70-39291 22-30)

16. GAS WELLS ON THE MOON R. O. Shotts (Ala. Univ., Univ.) p 131–133 refs (See N70-39292 22-30)

17. DEVELOPING A LUNAR DRILL: A 1969 STATUS REPORT R. L. Schmidt (Bur. of Mnes, Mpls., Minn.) p 135–144 refs (See N70-39293 22-15)

18. ELECTROWINNING OXYGEN FROM SILICATE ROCKS D. G. Kesterke (Bur. of Mines, Reno, Nev.) p 139–144 refs (See N70-39294 22-15)

N70-39282*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

METHODS OF WATER DETERMINATION (SURFACE AND ORBITAL)

Isidore Adler *In its* Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 53–59 refs (See N70-39276 22-30)

Avail: SOD $1.50; NTIS CSCL 22A

Two methods of lunar water determination for surface missions and one for orbital missions are described. Designs of aluminum oxide hygrometers to be inserted into soil are given. A neutron analysis method is based on the characteristics of gamma rays produced by the interaction of neutron with matter. In the orbital method, the ratio of slow to fast neutrons is measured and serves to indicate the hydrogen content. N.E.N.

N70-39283*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ELECTROMAGNETIC DETECTION OF LUNAR SUBSURFACE WATER

S. H. Ward (Calif. Univ., Berkeley), G. R. Jiracek (Calif. Univ., Berkeley), and R. J. Phillips (JPL) *In its* Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 61–73 refs (See N70-37276 22-30)

Avail: SOD $1.50; NTIS CSCL 03B

Detection of subsurface water appears possible from a satellite in orbit around the moon by use of electromagnetic techniques. Plane-layered models of the moon were analyzed in the frequency range of 10 kHz to 100 MHz, yielding values of reflection coefficient, surface impedance, apparent dielectric constant, and apparent conductivity for normally incident plane waves. The variation of these quantities with frequency is dependent on the presence or absence of subsurface water (in either liquid or perma frost form); that is, a fraction of 1 percent of water, for a wide range of materials that might exist on the moon, yields characteristic signals. Measurements of other geophysical quantities are described. A typical system for the measurements is described based on the ISIS-A satellite. An orbit around the moon at an altitude of about 100 kilometers is suitable. Author

N70-39284*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A MANNED LUNAR MISSION FOR WATER EXPLORATION IN THE MARIUS HILLS

J. S. Choate, C. D. Mosbruger, V. M. Kemp, S. W. Johnson, and T. R. McGetchin *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 75–86 refs (See N70-39276 23-30)

Avail: SOD $1.50; NTIS CSCL 22A

A mission plan for lunar water exploration, the probable nature of lunar water sources, and detection methods are outlined. The Marius Hills region was chosen on the basis of topographic domes, accessibility, geological and geophysical interest, and available photographic coverage. It is felt that water could be chemically or physically bound in rocks, or in a free phase in permafrost or ice. Methods of detecting free water include direct sampling, electrical resistivity measurements, neutron logging techniques, mass spectrometry, reflection spectrum changes, and hydrometry. Infrared spectrometry is proposed for detecting bound water. During the planned 90-day mission, one of two three-man teams is assigned to the lunar shelter laboratory module and the other is scheduled to traverse the surrounding region in a mobile excursion vehicle. N.E.N.

N70-39285*# McDonnell-Douglas Co., Huntington Beach, Calif.

HYDROTHERMALLY ALTERED ROCKS AS A LUNAR AND MARTIAN WATER SOURCE

Jack Green *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 87–92 refs (See N70-39276 22-30)

Avail: SOD $1.50; NTIS CSCL 03B

Hydrothermally altered rocks are hydrous and may provide a source of water for the lunar and Martian base. Two major types of hydrothermal alteration thought to occur on the Moon and Mars are sulfur acid and halogen acid. Halogen acid alteration may be confined to the termini or thickened zones of ash flow tuffs or to high temperature fumarolic centers at flow sources. In the latter case, the amount of hydrothermal alteration is relatively slight. Sulfur acid alteration is more extensive. The hydrothermal envelopes surrounding volcanic vein-sulfur deposits can possibly provide over 150 liters of water per cubic meter of clay. Remote sensing techniques can be applied to detect sulfur compounds. Author

N70-39287*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A STUDY OF FRICTION AND ADHESION IN A SIMULATED LUNAR VACUUM
Stanley A. Fields *In its* Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 101–105 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 22A

A series of experiments was conducted to determine the problems of friction and adhesion in a simulated lunar environment. The tests were made in a vacuum 10 and 100 picotorr. The friction tests were conducted to determine the coefficient of friction between granular simulated lunar soils and metal test flats. The test flats were made of Steel AISI 1020 and Aluminum 7075. The granular soils were basalt and quartz in the size ranges 250 to 500 and 38- to 62-micron-diameter particles. The coefficient of friction for all samples was higher in vacuum than in air. Several types of granular simulated lunar soils in varying size ranges were used in the adhesion experiments. The test results indicate that some materials adhere readily while others do not, and that particle size and shape are influential in the adhesive strength of soils. Author

N70-39288*# Bureau of Mines, Minneapolis, Minn.
FRICTION TESTS IN SIMULATED LUNAR VACUUM
Wallace W. Roepke *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 107–111 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 22A

Techniques being used to perform friction testing of mineral materials in ultrahigh vacuum are described. Under the assumption that lunar surface materials may be completely degassed and atomically clean surface conditions may be encountered in breaking and handling these materials, an attempt is being made to provide information on frictional behavior of mineral surfaces under this worst case situation. Preliminary experiments show that ultrahigh vacuum environment produces substantial increases in the kinetic coefficients of friction for quartz surfaces. Author

N70-39289*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Space Sciences Dept.
COMMENTS ON LUNAR SURFACE ADHESION
J. A. Ryan and J. J. Grossman *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 113–115 refs (See N70-39276 22-30)
(Contract NAS7-307)
Avail: SOD $1.50; NTIS CSCL 22A

Adhesion experiments with terrestrial materials in ultrahigh vacuum are described and compared to results from Surveyor and Apollo 11 flights. It is felt that the experimental data are consistent with the Surveyor findings, especially when the surfaces are ultraclean. The findings indicate the following potential adhesion problems: The adhesion of ultraclean surfaces is relatively large; large surface charging produces a long range attractive force; the landing vehicle and astronauts would neutralize the charge provided the gas pressure in the vicinity of the fragment is at least 0.01 torr; and the large adhesion is produced primarily if not entirely by electrical charging. It is felt that Survayor and Apollo 11 experiences show adhesion posed no problems, but that this may not be universally true. N.E.N.

N70-39290*# Alabama Univ., University.
EXPLOSIVES AND THE LUNAR ENVIRONMENT
Robert M. Cox, Jr. *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 117–118 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 22A

The possible uses and problems of using conventional high explosives and nuclear explosives in lunar exploration are outlined. It is felt that the most suitable high explosive would be a blasting agent of high detonation velocity and high density. The uses would be in seismic exploration, lunar base construction, and mining. Lined-cavity shaped charges are considered to have great potential use, and may be the first explosives used. The application of nuclear explosives is expected to be limited to geophysical investigations, stripping overburden, and fragmentation of rock and ore. N.E.N.

N70-39291*# Alabama Univ., University.
EARLY WATER MINING ON THE MOON
Reynold Q. Shotts *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 119–129 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 22A

Mining methods and equipment for application to all conceivable lunar water deposits are discussed. It is expected that shallow drilling and mining probably will encounter fine to blocky material of small grain size. Drilling is thought to be the first type of mining, and the auger is considered superior to the calyx drill. Surface mining equipment described are the front-end loader, scraper loader, and the bulldozer. Indirect mining methods are outlined, and personnel and power requirements are also mentioned. N.E.N.

N70-39292*# Alabama Univ., University.
GAS WELLS ON THE MOON
Reynold Q. Shotts *In* NASA, Washington Proc. of the 7th Ann. Working Group on Extraterrest. Resources 1970 p 131–133 refs (See N70-39276 22-30)
Avail: SOD $1.50; NTIS CSCL 03B

Possible entrapment of volatives and gases below the lunar surface and methods of extracting them are briefly described. Arrangements for drilling and removing cuttings from a deep gas well are outlined. N.E.N.

N70-39302*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYTICAL DEVELOPMENT OF THE RELATIVE MOTION OF TWO CLOSE SATELLITES OF AN OBLATE PLANET
Richard W. Barbieri Aug. 1970 29 p refs Submitted for publication
(NASA-TM-X-65329; X-551-70-313) Avail: NTIS CSCL 03C

The purpose of this study is to describe the relative planar motion of two satellites which are close in comparison to their respective distances from the center of an oblate central body. The equations which govern the motion of one of the satellites with respect to the other were derived from a Lagrangian formulation and neglect the mutual attraction of the two satellites. The equations have been expanded to first order in eccentricity of the orbit of the reference satellite and also to first order in a small parameter which is a function of the oblateness of the central body. The results to first order eccentricity, neglecting oblateness, show that the motion is almost periodic. When the first order oblateness is included a secular term appears and the almost periodic behavior becomes superimposed upon a secular drift. Certain small divisors appear when the oblateness is included; in particular the rate of change of the argument of perigee appears in the form of linear combinations with multiples of the mean motion and the modified mean motion. Author

N70-39304*# Bellcomm, Inc., Washington, D. C.
ELECTRICAL CONDUCTIVITY AND TEMPERATURE OF THE LUNAR INTERIOR
W. R. Sill 2 Sep. 1970 13 p refs
(Contract NASw-417)
(NASA-CR-113544; TM-70-2015-3) Avail: NTIS CSCL 03B

An analysis of time domain recordings of the lunar surface magnetic field (Apollo 12) has been performed to provide electrical conductivity information to depths of about 300 km. Assuming a

dominant poloidal interaction leads to models with conductivities in the range from 3 × 0.001 to 0.01 mho/m below 200km. For a postulated pyroxenite composition of the lunar interior such conductivities correspond to temperatures in the range from 1200 to 1300 K. Other less conductive and cooler models are possible.
Author

N70-39406# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 235 27 Aug. 1970 p 1-4 refs (See N70-39405 22-34)
Avail: NTIS

News releases are presented on a Soviet-German joint conference on solar radiation experiment and on an international symposium of astronomers emphasizing comet flights. Abstracts on other astronomical literature are also included. J.A.M.

N70-39444# Academy of Sciences (USSR), Moscow. Inst. of Physics.
PLASMA MECHANISMS OF EMISSION IN PULSARS
S. A. Kaplan and V. N. Tsytovich 1970 22 p refs
(NP-18255) Avail: AEC Depository Libraries

Two possibilities are distinguished from the radiation mechanisms: fast particles that generate hf radiation when scattered by turbulent plasma pulsations, and particles accelerated by turbulent pulsations give the usual synchrotron radiation. In both cases, stimulated emission is possible and gives a cosmic maser effect or CASER effect (cosmic amplifier stimulated emission radiation) without which the very high effective brightness temperatures in pulsars can not be explained. It is concluded that the theory of plasma turbulence makes possible the estimation of parameters of the emitting region near pulsars and demonstrates the possibility of the CASER effect transforming the major part of the turbulent energy into radiation energy; and in a time less than the time of a subpulse, 0.001 sec, the plasma particles are able to accelerate up to very high energies, and can be one of the most important energy sources for the activity of supernova remnants.
NSA

N70-39468# Royal Observatory, Edinburgh (Scotland). Science Research Council.
REPORT OF THE ASTRONOMER ROYAL FOR SCOTLAND, YEAR ENDING 31 MARCH 1970
31 Mar. 1970 15 p refs
Avail: NTIS

Interstellar media, Magellanic clouds, photoelectric photometry, Michelson stellar interferometry, and photographic monitoring of the 3C345 quasar are reported as well as occultations, parallax, and analysis of stellar spectra. Techniques and instrumentation developed for astrophysical studies are discussed. Rocket spectrophotometry and photometry, and wide field, ultraviolet stellar spectroscopy are mentioned for space research. The use of a Schmidt type camera in satellite tracking is cited. J.M.

N70-39512*# Texas Center for Research, Austin.
OPTIMAL THREE DIMENSIONAL REENTRY TRAJECTORIES FOR APOLLO-TYPE VEHICLES
Walton E. Williamson, Jr. Jan. 1970 148 p refs
(Contract NAS9-9903)
(NASA-CR-108649) Avail: NTIS CSCL 22C

A numerical optimization method, the perturbation method, is used to calculate optimal three dimensional reentry trajectories for Apollo-type vehicles. A linear combination of the convective heating and the integral of the acceleration are minimized. The only control of the vehicle is the roll angle which specifies the orientation of the lift vector. The initial conditions for reentry are chosen to correspond to those encountered by an Apollo vehicle returning to the earth from a lunar mission. Specified terminal conditions are consistent with those required just prior to the opening of a drogue parachute. Optimal trajectories obtained for the conditions described are skip trajectories with high acceleration peaks. The perturbation method is modified so that it may be used to calculate optimal trajectories with state variable inequality constraints. The modified perturbation method is used to calculate optimal reentry trajectories with an altitude inequality constraint over the skip segment of the trajectory.
Author

N70-39533*# Bellcomm, Inc., Washington, D.C.
A COMMENT ON NESS'S ESTIMATE OF THE INTERIOR ELECTRICAL CONDUCTIVITY OF THE MOON
W. R. Sill 2 Sep. 1970 12 p refs
(Contract NASw-417)
(NASA-CR-113601; B70-09003) Avail: NTIS CSCL 03B

Estimates of the internal electrical conductivity and temperature of the moon, made by Ness are based on the assumption that the response of the moon to discontinuities in the interplanetary field will lead to an increase in the risetime of the discontinuity as observed in the lunar wake. Calculations of the time domain response of the moon show that the response is characterized by a rapid increase with the same time scale as the discontinuity, followed by an overshoot and then a decay. This result is in contradiction to the interpretation of Ness. The increase in risetime that is observed must be attributed to other effects and the estimates of the conductivity, based on this interpretation, must be discounted.
Author

N70-39765*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE PREDICTION OF CORONAL AND INTERPLANETARY MAGNETIC FIELDS
K. H. Schatten Sep. 1970 11 p refs Presented at the AIAA Observation and Prediction of Solar Activity Conf. Submitted for publication
(NASA-TM-X-65345; X-692-70-356) Avail: NTIS CSCL 03B

The advent of high speed digital computers and advances in the understanding of the solar atmosphere have enabled predictions of solar eclipse structure. The magnetic field models, their applications, and limitations are discussed. The effects of solar activity on coronal structure are also discussed. It was recently shown that a high degree of correlation exists between the mean photospheric field and the interplanetary magnetic field. A means for predicting the interplanetary magnetic field is a consequence of that work. An interpretation of this effect is presented that relates to models of the coronal magnetic field.
Author

N70-39768*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE EFFECTS OF NUCLEAR FORCES ON THE MAXIMUM MASS LIMIT OF NEUTRON STARS
Sachiko Tsuruta Sep. 1970 7 p refs Presented at the 46th IAU Symp., The Crab Nebula, Jodrell Bank, England, 5-7 Aug. 1970
(NASA-TM-X-65343; X-641-70-349) Avail: NTIS CSCL 03B

The problem of the maximum mass limit of a stable neutron star is considered with respect to the models of pulsars and other phenomena believed to be caused by the presence of neutron stars. The neutron star models constructed by various groups are compared.
Author

N70-39785*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MISSION ANALYSIS DIVISION
In its Space Programs Sum. No. 37-63, Vol. 3 30 Jun. 1970 p 236-239 refs (See N70-39787 22-34)
Copyright. Avail: NTIS CSCL 22C

A preliminary analysis was performed to determine if there are any possible Jupiter-to-Pluto trajectories for the 1975 opportunity. A patched conic computer program was used to search for any possible Jupiter-Pluto trajectories. It was concluded from this

analysis that a 1975 Jupiter-Pluto mission is not feasible; inspection of other possible arrival dates established also that no combination of low launch energy and early arrival date results in a possible Jupiter-Pluto trajectory. Author

N70-39823*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERPLANETARY TRAJECTORY ENCKE METHOD FORTRAN PROGRAM MANUAL FOR THE IBM SYSTEM/360
Fred H. Whitlock, Henry Wolf (Analytical Mechanics Associates, Inc., Jericho, N.Y.), Leon Lefton (Analytical Mechanics Associates, Inc., Jericho, N.Y.), and Norman Levine Sep. 1970 159 p refs Submitted for publication
(NASA-TM-X-65342; X-643-70-330) Avail: NTIS CSCL 22C

A general purpose interplanetary trajectory Encke method (ITEM) program, programmed in the FORTRAN 4 language, is described. The method employed is designed to give the maximum available accuracy without incurring prohibitive penalties in machine time. The perturbations included in the program are the gravitational attractions of the Earth, Moon, Sun, Mercury, and the outer planets. The outer planets are considered as point masses. Additionally, the effects of the zonal and tesseral harmonics of the Earth, as well as aerodynamic drag, small corrective thrusts, and radiation pressure, including the shadow effect of the Earth, are considered. The input may be prepared in any one of several common systems, and a great variety of output options are available. Author

N70-39830# California Univ., Los Angeles. School of Engineering and Applied Science.
ON OPTIMUM CONTROL SYSTEMS WITH VARIATIONS IN INITIAL CONDITIONS
Cheng-An Wu Apr. 1970 106 p refs
(Contract F04701-69-C-0182; Grant AF-AFOSR-699-67)
(AD-708151; UCLA-70-31; AFOSR-70-1774TR) Avail: NTIS CSCL 12/1

The dissertation considers the effect of changes in initial conditions on the trajectories of control systems described by a set of ordinary nonlinear differential equations. The analysis is based on the formation of sensitivity functions about the nominal trajectory. Sensitivity functions are used to investigate the changes in terminal conditions and cost function due to deviations in initial conditions. Bounds on the deviations in initial conditions are found so that the desired terminal conditions are satisfied within given tolerances. A direct method called the conjugate gradient method is considered. Its associated properties, such as monotonic convergence, existence, uniqueness, etc. are discussed. The mars entry problem is formulated. TAB

N70-39838*# Scientific Translation Service, Santa Barbara, Calif.
LUNAR SPRINGBOARD EFFECT [L'EFFET DE TREMPLIN LUNAIRE]
Vicente Camarena Washington NASA Sep. 1970 13 p refs Transl. into ENGLISH from La Rech. Aerospatiale (France), no. 2, Apr. 1970 p 64–68
(Contract NASw-2035)
(NASA-TT-F-13253) Avail: NTIS CSCL 22C

The problem of minimizing the sum of velocity impulses to acquire a given velocity starting from a low orbit around the earth and at a great distance from the earth-moon distance is considered. In this case the problem can be decomposed into three phases if the simplifying assumption of a lunar activity sphere is used. These are earth-moon transfer, hyperbolic passage near the moon, and acquisition of the particle velocity at infinity. The method of optimizing each of these three phases is discussed. The simple case of grazing flyby, which gives a velocity impulse saving of 158 m/s compared with direct ascent, is studied. Author

N70-39948*# Scientific Translation Service, Santa Barbara, Calif.
ON THE DETERMINATION OF THE DYNAMICAL OBLATENESS OF THE SUN AND OF THE COEFFICIENTS beta AND gamma OF THE GENERALIZED TENSOR OF ROBERTSON [SUR LA DETERMINATION DE L'APLATISSEMENT DYNAMIQUE DU SOLEIL ET DES COEFFICIENTS beta ET gamma DU TENSEUR DE ROBERTSON]
Christian Marchal Washington NASA Sep. 1970 17 p refs Transl. into ENGLISH from Rech. Aerospatiale (Chatillon-sous-Bagneux), no. 2, Mar.–Apr. 1970 p 57–62
(Contract NASw-2035)
(NASA-TT-F-13252) Avail: NTIS CSCL 03A

The motion of a probe on an heliocentric orbit under the influence of the relativistic effects and the oblateness of the sun is integrated up to second order terms. The coefficient gamma could be obtained with a great accuracy by the observation of laser beams coming from the probe and passing close to the sun. The coefficients Beta and J sub 20 could be deduced with limited accuracy from the observation of the perturbations of the orbit. The non-Newtonian advance of the perihelion of Mercury is known with an accuracy of 1% and results in a very helpful relationship between Beta and J sub 20. Some possible experiments are suggested and compared with the Viking project (Mars lander). The second order effects are too small to be useful. Author

N70-39864*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ALGORITHM FOR COMPUTING SPHERICAL PARTIALS
Raymond V. Borchers Feb. 1970 27 p refs
(NASA-TM-X-65338; X-553-70-49) Avail: NTIS CSCL 22C

A rapid method is presented for computing satellite acceleration, position partials, and partials with respect to harmonic coefficients in the earth's geopotential using spherical recurrences. Some timing estimates and accuracy comparisons are given as a function of order of the harmonics for two different satellites. Author

N70-39986*# Translation Consultants, Ltd., Arlington, Va.
MASCONS OF THE LUNAR MARIA [MASKONY VPADIN LUNNYKH MOREY]
M. S. Markov et al Washington NASA Sep. 1970 9 p refs Transl. into ENGLISH from Priroda (Moscow), no. 3, 1970 p 84–87
(Contract NASw-2038)
(NASA-TT-F-13235) Avail: NTIS CSCL 03B

Observation of the flight path of Lunar Orbiter 5 resulted in determining that the station moved over various areas of the lunar surface at varying rates of speed, attesting to irregularities in the moon's gravitational field. Certain circular marias showed the greatest anomalies and it was concluded that moscons were associated with the maria in question. Author

N70-40016* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRETCH DE-SPIN MECHANISM Patent
Joseph V. Fedor and Henry J. Cornille, Jr., inventors (to NASA) Issued 18 Jan. 1966 (Filed 12 Mar. 1963) 6 p Cl. 244-1
(NASA-Case-XGS-00619; US-Patent-3,229,930; US-Patent-Appl-SN-264728) Avail: US Patent Office CSCL 22B

A stretch Yo-Yo mechanism is described for controlling the initial spin rate of a space vehicle. Stretchable cords or coiled springs are substituted for the elongated wires of the ordinary nonstretchable Yo-Yo. The stretchable cords provide a capability of compensating for errors in the initial spin rate and of compensating for variations in the spin axis moment of inertia of the satellite and last stage rocket in combination. Two cords with weights attached to one end are symmetrically wrapped around the periphery of the satellite in a plane normal to the spin axis and are secured in place by a release mechanism. The angular momentum of the satellite is transferred to the weighted cords and the spin of the satellite is reduced to the desired value. R.B.

N70-40032 Michigan Univ., Ann Arbor.
A 21-cm STUDY OF THE SPIRAL GALAXY MESSIER 33
Kurtiss Jay Gordon (Ph.D. Thesis) 1969 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-18012

The distribution of neutral atomic hydrogen and the kinematic properties of the late-type spiral galaxy M33 are derived from observations obtained at 21-cm wavelength with a multichannel radiometer attached to the 300-foot paraboloidal transit telescope of the National Radio Astronomy Observatory. The galaxy contains neutral hydrogen distributed in a broad ring of 18 ft radius plus an underlying uniform distribution of radius approx 35 ft and two outlying wings or companions. The companions contain approx 10% of the total hydrogen content. The center of the H I ring and of the distributions of H 2 regions and luminous stars in M33 are offset by a few minutes of arc from the optical center of the galaxy. The data are consistent with a picture of the wings as stable gaseous companions of M33, gravitationally bound to the galaxy but not physically connected to the galactic plane. Dissert. Abstr.

N70-40086*# TRW Systems Group, Redondo Beach, Calif.
SUBSYSTEMS TEST BED (STB) THERMAL MATH MODEL (TMM) DOCUMENTATION
T. B. Mobley, J. P. Smith, and R. E. Seward 29 Jun. 1970 253 p refs
(Contract NAS9-9392)
(NASA-CR-108826; Rept-12245-H004-R000) Avail: NTIS CSCL 22B

The thermal math models utilized to complete the six task assignments under the subsystems test bed contract are documented. They include: (1) STB TMM, a full size model used for test planning, instrumentation planning, pretest predictions, and post test data correlation. (2) STB Quarter Section TMM, a more finely nodalized model of the STB Quarter Section between the −Z and +Y axes used to correlate the detailed instrumentation on the STB pressure shell. (3) Standoff TMM, a model of a typical standoff section used to correlate standoff instrumentation. Author

N70-40137*# Scientific Translation Service, Santa Barbara, Calif.
CARBONACEOUS CHONDRITES [UGLISTYE KHONDRITY]
L. G. Kvasha Washington NASA Sep. 1970 11 p refs Transl. into ENGLISH from the book 'Abiogenez i Nachalnyye Stadii Evolyutsii Zhizni' Moscow, Nauka Press, 1968 p 16–22
(Contract NASw-2035)
(NASA-TT-F-13183) Avail: NTIS CSCL 03B

A discussion of the structural characteristics and chemical and mineralogical composition of carbonaceous chondrites, based on published materials and presented in an attempt to extend existing knowledge concerning abiogenetic synthesis of organic compounds is given. Fluctuations in the content of the principal elements and their oxides in carbonaceous chondrites are tabulated. Indications are found that carbonaceous chondrites were not heated during their formation. A relation is believed to exist between the gaseous components of carbonaceous chondrites and their silicate components. Author

N70-40149*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
THE MARCH ECLIPSE FROM SANTA MARIA TONAMECA
Theodore J. Pepin May 1970 18 p
(Contract N00014-67-A-0113-0004)
(AD-708745; AP-33) Avail: NTIS CSCL 3/2

A group consisting of Dr. Herman Haupt, Dr. Maria Firneis and Engineer Gerhard Klement of the University Observatory of Vienna, Austria along with the author collaborated in an experiment to measure the brightness and polarization of the corona during the March 7, 1970 total eclipse of the sun. Author (TAB)

N70-40205*# Virginia Univ., Charlottesville. Leander McCormick Observatory.
PRINCIPLES OF ASTRONOMICAL SPECTROSCOPY
Robert J. Doyle and Laurence W. Fredrick 1969 68 p refs
Avail: NTIS

Research in theoretical and experimental aspects of various types of spectroscopy is reported. Dispersion and diffraction is reviewed with respect to prisms, gratings, and parallel slits. Spectroscopic resolving power is mentioned, and conventional spectroscopic equipment and operation are discussed. The theory of interference spectroscopy is outlined, and the applications of the Fabry–Perot interferomenter in astronomy are described. The characteristics, efficiency, and applications of a Fourier transform spectrometer are also discussed. N.E.N.

N70-40207*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCIENCE AND THE ACCELERATION OF TECHNICAL PROGRESS
8 May 1970 10 p Transl. into ENGLISH from Pravda (Moscow, 31 Mar. 1970 p 6
(AD-707313; FTD-HT-23-259-70) Avail: NTIS CSCL 5/2

A question was put to a group of physicists from a number of different cities in the country: What, in your opionion, should be done to increase the contribution of Soviet science to accelerated scientific and technical progress. The replies of the participants of this informal round table are given. Author (TAB)

N70-40226*# California Univ., Los Angeles. School of Engineering and Applied Science.
BAYESIAN NONLINEAR FILTER DESIGN FOR SPACECRAFT TERMINAL GUIDANCE
Frederick A. Evans Apr. 1970 183 p refs
(Contract F04701-69-C-0182; Grant AF-AFOSR-699-67)
(AD-708124; UCLA-70-25; AFOSR-70-1776TR) Avail: NTIS CSCL 22C

The research applies Bayesian methods to the design of a nonlinear filtering algorithm for digital computers. It is generally recognized that nonlinear filters require important approximations for practical realization, and hence the design details are not independent of the application. A sequential digital filtering technique is developed and applied to the important problem of Mars landing terminal guidance. A detailed digital simulation is conducted to examine the performance of the nonlinear filter of this research. The guidance system is simulated in closed loop fashion and the performance of the system using the nonlinear filter is compared with the performance of the same system using the minimum variance linear filter. The results of the simulation study indicate that the nonlinear filter of this research provides improved performance over the linear filter, particularly in initial filter response. Terminal landing is accomplished accurately and efficiently. TAB

N70-40309* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
PASSIVE COMMUNICATION SATELLITE Patent
Warren Gillespie, Jr., inventor (to NASA) Issued 23 Nov. 1965 (Filed 13 Jan. 1961) 15 p Cl. 343-18
(NASA-Case-XLA-00210; US-Patent-3,220,004; US-Patent-Appl-SN-82658) Avail: US Patent Office CSCL 22B

The satellite described is designed to be pervious to light frequency waves; impervious to radio frequency waves, and is adapted to be attitude stabilized by the gravitational-centrifugal force gradient. The inflatably erectable satellite is folded into a compact package for storage in a launch vehicle nose cone or in the final stage of a multistage rocket; upon erection, it has at least one spherical section for presentation to a source of radio frequency signals transmitted from the earth. The inflatable elements are constructed of material in sheet form adapted to reflect the radio frequency waves. The satellite is so constructed as to possess structural rigidity upon erection sufficient to retain an erected configuration in an interplanetary spatial vacuum without the presence of internal pressure. Any one of several configurations may be

selected, each configuration comprising a primary structure including a mast, an annular support means, and a plurality of lightly tensioned spokes, and a secondary structure including the spherical section. P.A.B.

N70-40353* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MISSILE LAUNCH RELEASE SYSTEM Patent
Timothy O. Eddins, inventor (to NASA) Issued 21 Dec. 1965 (Filed 25 May 1964) 7 p Cl. 89-1.7
(NASA-Case-XMF-03198; US-Patent-3,224,336; US-Patent-Appl-SN-370134) Avail: US Patent Office CSCL 22D

An apparatus for reducing the bending moment change rate in a missile thrust distribution structure when the missile hold down clamps are released at liftoff is described. A predetermined constant retarding force which is independent of the vehicle's nonzero velocity and is effective for a predetermined time and distance after liftoff is provided. The apparatus requires no calibration prior to launch and is not affected by environmental extremes. A plurality of energy absorbers form the means for applying the retarding force. These energy absorbers include a tube pivotally anchored to the launch pad, a rod pivotally attached to the missile's thrust distribution structure, and a mandrel, having a maximum external transverse dimension greater than the maximum transverse dimension of the interior surface of the tube, positioned within the tube and attached to the free end of the rod. The tube is extruded by the mandrel when there is relative movement of the missile with respect to the launch pad, and the stresses developed in the tube remain less than the tube's ultimate strength. P.A.B.

N70-40388# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME 5, NO. 3 Quarterly Report
Anne L. Carrigan and Norman J. Oliver, eds. 1968 267 p
(AD-680665; QR-3) Avail: NTIS CSCL 3/2

The Geophysics and Space Data Bulletin is a quarterly publication that contains Air Force Cambridge Research Laboratories contract and inhouse data reported from sites throughout the world. Author (USGRDR)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N70-39006+ Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR JANUARY 1968, PART 1
1969 57 p *Its* Issue No. 2
Avail: NTIS

Azimuth, elevation, and time data are tabulated for the following satellites: Echo 1 satellite, Ariel 1 satellite, Injun 3 rocket, Thor Agena B, Polyot 1 satellite, and Explorer 19 satellite. N.E.N.

N70-39007+ Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR JANUARY 1968, PART 2
1969 72 p *Its* Issue No. 2
Avail: NTIS

Azimuth, elevation, and time data are tabulated for the following satellites: Echo 2 satellite, Thor Agena D, Nimbus 1 rocket, Cosmos 44 satellite, Explorer 24 satellite, Cosmos 55 satellite, Cosmos 58 rocket, and Cosmos 71 rocket. N.E.N.

N70-39008+ Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR JANUARY 1968, PART 3
1969 89 p *Its* Issue No. 2
Avail: NTIS

Azimuth, elevation, and time data are tabulated for the following satellites: Explorer 32 satellites, Pageos 1, OV3-2 rocket, Cosmos 145 Satellite, Ariel 3, satellite, Cosmos 196 satellite, Cosmos 198 satellite, and unknown satellites. N.E.N.

N70-39231*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANGLE-OF-ATTACK ANALYSIS OF A SPINNING SLENDER CONE WITH SLIGHT AERODYNAMIC AND MASS ASYMMETRIES (REENTRY F)
Gerard E. Woodbury and W. Douglas Morris Washington Sep. 1970 38 p refs
(NASA-TN-D-5948; L-7215) Avail: NTIS CSCL 22B

An analysis of the flight motions of the Reentry F spacecraft was made by using a combination of a force method and an application of the angular-rate solution of the linearized equations of motion since a trim buildup due to flight-induced asymmetries introduced an error into the ordinarily determined angle of attack. The analysis revealed that the spacecraft had little or no asymmetries prior to and during pitch-roll resonance. However, as the spacecraft emerged from resonance, a slight trim angle of attack was noted which shortly thereafter experienced a reversal in orientation and a subsequent rapid growth in the same general direction to a maximum of 0.87 deg. Author

N70-39414*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LAUNCH VEHICLE SRT
In its Res. and Advanced Develop. 31 Aug. 1970 p 31–43
(See N70-39411 22-34)
Avail: NTIS CSCL 22B

Identified are future missions which will require the addition of new high-energy upper stages to existing launch vehicles. Attention is focused on solid rocket stage performance, including the new beryllium stop-start technology motor. Author

N70-39418*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CENTAUR: ORBITING ASTRONOMICAL OBSERVATORY NOSE FAIRING ALTITUDE JETTISON TEST
Charles W. Eastwood Washington Sep. 1970 62 p refs
(NASA-TM-X-2096; E-5673) Avail: NTIS CSCL 22B

An experimental investigation was conducted to verify the functional and structural capability of the Centaur - OAO-A2 nose fairing at the jettison altitude predicted for the first Centaur-OAO flight. A full-scale fairing specimen was exposed to the simulated atmospheric pressure associated with the flight jettison event. Three complete jettisons of the fairing were performed, one with the redundant separation system disabled. Nose fairing specimen trajectories, structural deflections, clearances, hinge forces, and shock loads in the simulated pressure environment are presented. Several subsystem component parameters were established and are presented. Data from the subsequent Centaur-OAO flight are compared with the experimental results. Author

N70-39451*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
DESIGN AND FABRICATION OF A FULL-SIZE LANDING IMPACT TEST MODEL OF THE MARS LEGGED LANDER

CONFIGURATION Master Agreement, Task Order Three
O. R. Otto, R. A. Melliere, and A. Lopatin Washington NASA Sep. 1970 82 p refs
(Contract NAS1-8137)
(NASA-CR-111771) Avail: NTIS CSCL 22B

A description is presented of the landing impact test model of the Mars legged lander configuration. The model is a full size, variable mass legged lander containing three inverted tripod landing gears to be used for soft landing investigations with either 3/8 prototype mass properties or full prototype mass properties. Loading conditions, based on energy absorption characteristics of landing gear and on anticipated landing accelerations, are described. Strength analyses, and minimum margins of safety for all critical parts verifying structural adequacy of the model, are presented. Model mass properties are shown to be within specified constraints for both 3/8 prototype mass model and full prototype mass model. Author

N70-39603*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SPACE TRANSPORTATION SYSTEM TECHNOLOGY SYMPOSIUM. VOLUME 5: OPERATIONS, MAINTENANCE, AND SAFETY (INCLUDING CRYOGENIC SYSTEMS)
July 1970 220 p refs Held at Cleveland, 15–17 Jul. 1970
(NASA-TM-X-52876-Vol-5; E-5866-Vol-5) Avail: NTIS CSCL 22

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10. CRYOGENIC PROPELLANT ACQUISITION AND TRANSFER R. E. Tatro (Gen. Dyn./Convair, San Diego, Calif.) p 167–187 (See N70-39613 22-28)

11. CRYOGEN SYSTEMS HARDWARE TECHNOLOGY REVIEW FOR THE SPACE SHUTTLE D. K. Huzel (N. Am. Rockwell Corp., Downey, Calif.) p 189–201 (See N70-39614 22-28)

12. CRYOGENIC SYSTEMS INTEGRATION TECHNOLOGY FOR THE SPACE SHUTTLE J. D. Schweikle (McDonnell-Douglas Astron. Co., Huntington Beach, Calif.) p 203–214 (See N70-39615 22-28)

13. SPACE SHUTTLE CRYOGENIC TECHNOLOGY REVIEW C. C. Wood (NASA, Marshall Space Center) p 215 (See N70-39616 22-28) For Vol. 1, See N70-27826 through N70-37847; for Vol. 2, See N70-36595; and for Vol. 5, see N70-39603 through N70-39616.

N70-39604*# Pan American World Airways, Inc., Patrick AFB, Fla.
COMMERCIAL AIRCRAFT TECHNOLOGY APPLICABLE TO THE SPACE SHUTTLE
Charles L. Carroll *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 1–32 refs (See N70-39603 22-31)
Avail: NTIS CSCL 22B

Certain topics in commercial aircraft technology with potential application to the space shuttle have been briefly reviewed. It can be concluded that much commercial aircraft technology available in 1975 will be directly applicable. This includes maintainability, maintenance, avionics, management techniques, and operations. Strongly recommended is: (1) that airline management, engineering, maintenance and operations techniques be used in the procurement, design, test and operation of the space shuttle; and (2) insofar as possible only technology available in the 1975 time frame - so called - off the shelf technology be used in the space shuttle. Author

N70-39608*# Grumman Aerospace Corp., Bethpage, N.Y.
INTACT ABORT TECHNOLOGY REQUIREMENTS
T. Barnes *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp. Vol. 5 Jul. 1970 p 91–102 (See N70-39603 22-31)
Avail: NTIS CSCL 22A

Studies of two-stage, fully recoverable, earth orbital shuttle systems indicate that the requirements for safe, intact abort capability in both the booster and the orbiter could have significant effects on the design of these vehicles. This paper are to briefly identifies these potential effects, presents some preliminary study results, and recommends areas to be emphasized in future studies. The major study areas considered thus far include: (1) minimum safe abort altitude; (2) propellant depletion; (3) orbiter ability to fly back; and (4) orbiter ability to abort-to-orbit. Author

N70-39609*# Spar Aerospace Products, Ltd., Toronto (Ontario).
USE OF EXTENDIBLE BOOM DEVICES FOR SPACE SHUTTLE AND EVA OPERATIONS
H. Robert Warren *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 103–126 (See N70-39603 22–31)
Avail: NTIS CSCL 22B

Given is a state-of-the-art review on a particular device that could have wide application in orbital maintenance and safety activities on the space shuttle. This is the extendible boom device for which we use the general term of STEM. Illustrations are given of STEM units that have already been developed and have either flown, or been qualified for flight. Reviewed are current and future developments which have more direct relevance to the space shuttle program; provided is also a brief summary of design characteristics that are available to the designer for future space shuttle applications. Author

N70-39610*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REQUIREMENTS FOR SPACE SHUTTLE SYSTEMS
Charles C. Wood *In its* Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 127–132 (See N70-39603 22-31)
Avail: NTIS CSCL 22B

Considered are the following three factors: (1) to identify for the space shuttle vehicle the systems utilizing cryogens; (2) to identify the technology disciplines which must be addressed by the designer; and (3) to identify the specific shuttle requirements which appear to most adversely affect the design of cryogenic systems. Author

N70-39611*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CRYOGENIC TECHNOLOGY BASE FOR SPACE SHUTTLE

A. L. Worlund and T. W. Winstead *In its* Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 133–145 refs (See N70-39603 22-31)
Avail: NTIS CSCL 22B

The cryogen technology available to the space shuttle is more mature and comprehensive than that on which previous launch vehicles were designed and developed. The disciplines and flight application are summarized. The data is sufficient to select baseline concepts with the following exceptions: (1) orbit stratification; and (2) orbit mass gauging. Author

N70-39612*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRYOGENIC INSULATION TECHNOLOGY REVIEW FOR THE SPACE SHUTTLE
James R. Barber *In its* Space Transportation System Technol. Symp., Vol. 5 Jul. 1970 p 146–166 refs (See N70-39603 22-31)
Avail: NTIS CSCL 22B

Several insulation systems potentially useful for the space shuttle have been discussed. Supporting research and technology efforts are currently underway for three such systems. These are: (1) internal foam; (2) internal gas barrier; and (3) external multilayers. Author

N70-39626*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE TRANSPORTATION SYSTEM TECHNOLOGY SYMPOSIUM. VOLUME 14: PROPULSION
Jul. 1970 381 p refs Conf. held at Cleveland, 15–17 Jul. 1970
(NASA-TM-X-52876-Vol-4; E-5866-Vol-4) Avail: NTIS CSCL 22B

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4. TECHNOLOGY ISSUES FOR SHUTTLE MAIN ENGINE: STAGE INTEGRATION A. L. Worlund, T. W. Winstead, and W. B. McAnelly (NASA, Marshall Space Flight Center) p 122–143 refs (See N70-39630 22-28)

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7. SPACE SHUTTLE HIGH PRESSURE AUXILARY PROPULSION SYSTEM A. Shaffer (AiResearch Mfg. Co., Los Angeles), H. L. Burge, and J. Cuffe (TRW Sys. Group., Redondo Beach, Calif.) p 189–223 (See N70-39633 22-28)

8. TECHNOLOGY FOR THE DEVELOPMENT OF A GASEOUS HYDROGEN-GASEOUS APS ENGINE FOR THE SPACE SHUTTLE A. Seidel (Messerschmitt-Boelkow G.m.b.H., Munich, West Germany) p 225–250 (See N70-39634 22-28)

9. SPACE SHUTTLE AUXILARY PROPULSION TECHNOLOGY REQUIREMENTS K. D. Coates (NASA, Marshall Space Flight Center) p 251–264 (See N70-39635 22-28)

10. SPACE SHUTTLE AUXILARY PROPULSION TECHNOLOGY PLANS D. L. Nored p 265–290 (See N70-39636 22-28)

11. ENGINE DESIGN AND TECHNOLOGY REQUIREMENTS (PANEL DISCUSSION) p 291–378 (See N70-39637 22-28)

For Vol. 1, see N70-27826 through N70-37847; for Vol. 2, See N70-36595; and for Vol. 4, See N70-39626 through N70-39627.

N70-39644*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE VEHICLE SYSTEMS SRT
In its Res. and Advanced Develop., Vol. 2 15 Feb. 1970 p 219–315 refs (See N70-39642 22-34)
Copyright. Avail: NTIS HC$10.00/MF$.65 CSCL 22B

Studies on space vehicle aerothermodynamics, structures, design criteria, and space environmental factors are discussed. R.B.

N70-39703# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF CONTROL OF THE MOTION OF SPACECRAFT (SELECTED CHAPTERS)
V. M. Ponomarev 20 Apr. 1970 363 p refs Transl. into ENGLISH from the Russian
(AD-708325; FTD-MT-24-33-70) Avail: NTIS CSCL 22/1

An attempt is made to propose a joint theoretical solution of two problems: development of a general theory of controlled motion of spacecraft and development of general principles of construction of systems for controlling their motion. Some of the principles proposed by the author can be used not only for control of spacecraft, but also in systems for controlling the motion of other objects. The following topics are included in this translation: controlled motion of spacecraft; optimum control of motion of spacecraft; methods for determination of optimum programs of control; program of control during approach of spacecraft; program of control during descent in an atmosphere; perturbation influences; optimum laws of control. The book is intended for a wide circle of engineers and scientists who are occupied with problems of automatic control, and also for students in senior courses who are specializing in this field. TAB

N70-39774*# Massachusetts Inst. of Tech., Cambridge.
EFFECTS OF STRUCTURAL FLEXIBILITY ON LAUNCH VEHICLE CONTROL SYSTEMS
NASA Feb. 1970 51 p refs Sponsored by NASA
(NASA-SP-8036) Avail: NTIS CSCL 22B

Control during the boost phase is considered, including the significant effects of space vehicle structural feedback on the control system. The state of the art, encompassing the definition of the problem and previous design and flight experiences, is reviewed. Structural feedback problems examined include vehicle body deformation, local deformations, transient response problems, environmental problems, and other predicted phenomena. Design criteria are then discussed. Design verification includes analytical studies using proven methods and mathematical models, simulation studies, and tests to ensure that assumptions made during the first two studies are valid and that system performance and stability requirements are met. An extensive bibliography is included. P.A.B.

N70-39919# International Geophysical Year World Data Center A, Washington, D.C.
ROCKETS AND SATELLITES: CATALOG OF DATA, 1 JANUARY–30 JUNE 1970
Jul. 1970 71 p
Avail: Issuing Activity

Information on geophysical and meteorological phenomena obtained from launching of sounding rockets, artificial earth satellites, and space probes is reported. A listing of reports and reprints is given by subject and country. R.B.

N70-40230*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DELTA AND THOR/AGENA LAUNCH VEHICLES FOR SCIENTIFIC AND APPLICATIONS SATELLITES
Charles R. Gunn Sep. 1970 45 p
(NASA-TM-X-65333; X-470-70-342) Avail: NTIS CSCL 22B

The Delta and Thor/Agena medium class launch vehicles are described for potential users. Functional description of the

vehicles, their performance, flight environment, organizational interfaces, spacecraft integration requirements, launch operations and costs are provided for Delta Modal 904, and Thor/Agena Model 9A4. Projected vehicle growth currently under study is highlighted.
Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N70-39010# Asian Inst. of Tech., Bangkok (Thailand).
THE FINITE ELEMENT METHOD IN PLATE BENDING ANALYSIS: TRIANGULAR ELEMENTS WITH ASSUMED STRESS DISTRIBUTIONS
Terng-Fen Song (M.S. Thesis) 1970 75 p refs
(Thesis-294) Avail: NTIS

A derivation method for plate element stiffness matrices based on minimum complementary energy using assumed stress distributions is described. Examples of square plates in bending are investigated. Emphasis is placed on solving a series of clamped square plates of various mesh sizes subjected to uniform loading. An idea of the accuracy of each mesh size is obtained by comparison with a known analytical series solution. The finite element solution shows an improvement in structural analysis when the element stiffness matrices satisfy both internal equilibrium and displacement compatibility with adjacent elements. Results are compared with those of another approach in which a displacement function is employed.
Author

N70-39013# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
TABLES OF BAR BUCKLING EIGENFUNCTIONS AND THEIR INTEGRALS
S. Durvasula and M. S. S. Prabhu Sep. 1969 76 p refs
(AE-255S) Avail: NTIS

The tables of buckling eigenfunctions of a uniform bar and their derivatives are given for different end conditions. The functions and their derivatives for the first six modes were tabulated at an interval of 0.02. Also, the formulae as well as the numerical values of the integrals involving these functions and their derivatives are given for different end conditions.
Author

N70-39034# Argonne National Lab., Ill.
NUMERICAL ALGORITHMS TO DETERMINE THE STRUCTURAL BEHAVIOR OF A CYLINDRICAL INVOLUTE FUEL PLATE UNDER STEADY-STATE LOADING
D. B. Taylor and A. H. Marchertas Feb. 1970 41 p refs
(Contract W-31-109-eng-38)
(ANL-7555) Avail: NTIS

Differential equations are derived describing the structural characteristics of a thin, cylindrical involute shell. The shell considered is of homogeneous construction and uniform in thickness, and is subject to a steady-state loading consisting of transverse pressure and internal thermal gradients. These are assumed to vary throughout the entire surface of the shell – in case of the temperature, also across the shell thickness. Boundary conditions are as follows: free involute ends of the shell; axial sides which are pinned, fixed, or what has been referred to as rotated. In their final form, a total of three partial differential equations are deduced in terms of tangential, axial, and transverse displacements. These equations are not solved, but possible methods of numerical solutions are discussed.
Author (NSA)

N70-39044# Holmes and Narver, Inc., Las Vegas, Nev. On-Continent Test Div.
TDYNE: A COMPUTER PROGRAM TO PERFORM MODAL AND TIME DEPENDENT DYNAMIC ANALYSIS OF SPRING-MASS SYSTEMS WITH CRUSHABLE AND JUMPING BASES SUBJECT TO GROUND MOTION
R. P. Kennedy Jun. 1969 105 p refs Sponsored by AEC
(HN-20-1027) Avail: NTIS

TDYNE was developed to study the response of structures to ground motion from underground nuclear explosions. This program determines all desired natural frequencies and mode shapes for any spring mass system with up to 80 lumped masses and 120 springs. Additionally, for any inputted ground motion-time history and modal viscous damping this program determines: 1) the relative displacement-time history response for any three masses of the system plus the peak positive and negative displacement responses and their times of occurrence for all masses; 2) the force-time history response for any three springs of the system plus the peak positive and negative force response and their times of occurrence for all springs; 3) the base acceleration-time history; 4) the total jumping and crushing deflection at each time increment; and 5) the dynamic base reaction-time history.
NSA

N70-39048# Holmes and Narver, Inc., Las Vegas, Nev. On-Continent Test Div.
SPECANAL: A COMPUTER PROGRAM TO GENERATE RESPONSE SPECTRA, POWER SPECTRAL DENSITY, AND RESPONSE-TIME HISTORIES FOR ELASTIC SINGLE DEGREE OF FREEDOM OSCILLATORS WITH VISCOUS DAMPING SUBJECTED TO DIGITIZED GROUND MOTION-TIME HISTORIES
R. P. Kennedy Oct. 1969 161 p refs Sponsored by AEC
(HN-20-1030) Avail: NTIS

The response spectra which can be generated are peak positive, peak negative, and absolute peak relative displacement, relative velocity, and absolute acceleration. Time of occurrence of each of these peak responses are outputted. Pseudo relative velocity and pseudo absolute acceleration response spectra may also be generated. All response spectra are outputted as a function of natural frequency and viscous damping ratio. Whenever the peak structural responses occur in the free vibration era after the inputted ground motion these peak free vibration response are automatically calculated and incorporated into the response spectra. Thus there is no requirement for incorporating the free vibrations era into the inputted ground motion record. Power spectral densities as a function of natural frequency may be generated for either the entire inputted ground motion record or for any portion of this record. For specific natural frequencies and damping ratios both plotted and printed displacement response-time histories can be obtained.
Author (NSA)

N70-39082 California Univ., San Diego.
SOME PLANE PROBLEMS IN FINITE AND INFINITESIMAL PLASTICITY WITH ISOTROPIC AND KINEMATIC WORKHARDENING
Jenn-Ming Chern (Ph.D. Thesis) 1969 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-19698

Finite and infinitesimal deformation of an infinitely extended, axisymmetric disk of a nonuniform initial thickness with a circular hole is considered. The disk is loaded along the interior surface of the hole by pressure and twisting moment of nondecreasing magnitudes. A state of plane stress is assumed, and the incremental theory of plasticity is used. The material of the disk is assumed to be rigid-plastic for finite deformation, and elastic-plastic for infinitesimal deformation. When the twisting moment is absent, complete solutions are obtained for the isotropic hardening law and for either the Mises yield criterion and its associated flow rule or the Tresca yield criterion and the flow rule. An interesting feature of our result is that, when material hardening exists, then, as the hole expands, there first occurs a thickening of the disk, at the vicinity of the hole's edge, which thickening may then be followed by a thinning.
Dissert. Abstr.

N70-39112 Michigan Univ., Ann Arbor.
A LINEAR MEMBRANE THEORY FOR PRESSURIZED AXISYMMETRIC SHELLS
John Thomas Tielking (Ph.D. Thesis) 1969 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-18122

The modified linear membrane theory described is a result of investigation into the nature of the predicted singularity in the deformed midsurface of a toroid. A linear theory is presented for approximating the solution obtained from the nonlinear equations. The modified linear equations are obtained by introducing two new variables, the midsurface rotation and the normal displacement into the stress equilibrium equations. Two additional coupled equations which insure continuity of the deformed midsurface are constructed from geometric arguments. The resulting boundary value problem consists of four first order linear differential equations in four unknowns. Solutions for the pressurized ellipsoid and toroid are obtained by use of the Ritz method. The toroid solution is compared with previously published solutions to nonlinear membrane equations. Dissert. Abstr.

N70-39114 City Univ. of New York.
ON BENDING OF CURVED TUBES
Henry Jules Thaler (Ph.D. Thesis) 1969 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-19069

The stress distribution and flexibility of thin-walled curved circular tubes, with and without flanges, subjected to in plane end couples are investigated. A general solution for a curved circular tube viewed as an axisymmetric thin shell of revolution is obtained. The two dependant variables are expanded in trigonometric series such that they automatically satisfy one of the two coupled ordinary differential equations, namely, the equilibrium equation regardless of the value of radius ratio. A solution for a U-bend tube terminated by rigid end flanges is presented for the first time. Displacements and rotation are expanded in trigonometric series, thus insuring satisfaction of compatibility conditions. Equilibrium is guaranteed by minimizing the total potential energy in the manner of Rayleigh-Ritz. Numerical results are compared with experimental results. Dissert. Abstr.

N70-39120 Georgia Inst. of Tech., Atlanta.
PARAMETRIC EXCITATION OF NONPLANER MOTIONS OF AN ELASTIC ROD
Edward Charles Haight, Jr. (Ph.D. Thesis) 1969 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-18598

A theoretical and experimental examination was made of the loss due to parametric coupling of the stability of the planar steady-state forced response of a long slender elastic rod. Attention has been given to two methods of excitation. In the first, the rod is harmonically driven in the axial direction and the principal planar motion is the parametrically induced half-order subharmonic response. The second method for exciting the rod is to force it harmonically in a direction perpendicular to the rod axis; this excitation directly induces a harmonic plane steady-steady response. In both cases, nonplanar motions are parametrically coupled to the principal planar oscillations. It is the stability of the planar motions with respect to disturbances perpendicular to the original response plane which is investigated. Dissert. Abstr.

N70-39168 Michigan Univ., Ann Arbor.
FREE VIBRATION AND STEADY STATE ANSLYSIS OF AN ORTHOTROPIC CYLINDER
Robert Chester Haberman (Ph.D. Thesis) 1969 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-18015

The circumferential vibrations of an infinitely long orthotropic cylinder are analyzed using two approximate theories; thin shell theory and shear deformation-rotatory inertia theory, and linear elasticity theory. The approximate theories are developed in a manner analogous to those of an isotropic cylinder, and the linear elasticity theory is developed using a power series and an asymptotic series. All three theories are compared for the flexural modes of vibration. As a further investigation of the relative merits of these theories, the problem of an arbitrary pressure distribution moving at constant velocity around the circumference of an orthotropic cylinder is analyzed. Dissert. Abstr.

N70-39242# Oak Ridge National Lab., Tenn. Reactor Div.
CONCEPTUAL SYSTEM DESIGN DESCRIPTION OF THE INTERMEDIATE VESSEL TESTS FOR THE HEAVY SECTION STEEL TECHNOLOGY PROGRAM
C. L. Segaser Jun. 1970 87 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2849) Avail: NTIS

The program has among its objectives the demonstration of the capability to predict failure of flawed, heavy-wall pressure vessels tested under frangible, transitional and tough loading regimes. A series of tests intermediate between conventional laboratory tests and a full-scale vessel test are planned to permit characterization of the many parameters that influence fracture in an actual vessel. Since hydrostatic rupture of a thick-wall pressure vessel by brittle fracture can result in generation of high velocity missiles, the tests must be conducted under adequately safe conditions with the high-pressure equipment behind approved barricades. The conceptual design of a system and its associated equipment for safely conducting fracture tests at pressures up to 30,000 psig on the proposed vessels at wall temperatures ranging from about −50 to +350 F is described. These temperatures are estimated to bracket the anticipated vessel wall transition temperature. At least ten such tests are currently planned in the simulated service test program. Author (NSA)

N70-39252 Catholic Univ. of America, Washington, D.C.
FRACTURE AND CARRYING CAPACITY OF NOTCHED STRUCTURES
Hendrikus Hermanus Johannes Vanderveldt (Ph.D. Thesis) 1969 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-19775

The use of fracture mechanics principles in the design of such structural components as those encountered in portal frames is discussed. Through the use of the theory of elasticity, expressions are obtained giving the maximum stresses near sharp corners in terms of the nominal stresses present in the structural members. These expressions for the maximum stresses are then put into the fracture mechanics definition for the stress intensity value in terms of the existing maximum stress near the flaw. This calculated value for stress intensity is then equated to the stress intensity value of the material and thus the maximum load carrying capacity of the structural component is determined. Experimental and theoretical analyses of simple columns and portal frames are made in order to determine the feasibility of the approach. Dissert. Abstr.

N70-39262 Pittsburgh Univ., Pa.
COMBINED MODE FRACTURE MECHANICS
William Kent Wilson (Ph.D. Thesis) 1969 223 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-18385

Numerical methods for determining the stress intensity factors of cracked structures are developed. A boundary collocation method for determining the stress intensity factors of an interior through-thickness crack in a finite plate is introduced. The method is applicable to arbitrary plate geometry and arbitrary in-plane loading including tractions on the crack edges. A general finite element method for determining crack tip stress intensity factors is also introduced. This method incorporates a special crack tip element with the more conventional finite elements, and is specifically developed for circumferentially cracked axisymmetric bodies

subjected to torsion. The final numerical method presented is a boundary collocation procedure for single edge crack plates. It is applicable to arbitrary plate geometry and arbitrary in-plane loading. All three methods are applied to specific geometries and loading conditions to demonstrate their general applicability. Dissert Abstr.

N70-39330# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
FLUTTER OF CIRCULAR CYLINDRICAL SHELLS, A REVIEW
S. Parthan and D. J. Johns Nov. 1969 98 p refs
(TT-6917) Avail: NTIS

A comprehensive review is given of the aerodynamic and structural assumptions made in existing cylindrical shell flutter analyses. A review is also given of such analyses for shells of infinite and finite lengths, and a critical discussion of the results is included. Recommendations are made for future work, and a comprehensive chronological bibliography is appended. Author

N70-39337 Washington Univ., Seattle.
ANALYSIS OF AXISYMMETRIC PROBLEMS IN FRACTURE MECHANICS
Leon Wilford Moss (Ph.D. Thesis) 1969 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-18303

The results of an analytical investigation of a class of three dimensional boundary value problems generally associated with the linear theory of fracture mechanics are presented. The problems considered may be represented by a set of dual or triple integral equations. In order to solve this set of equations, an equivalent two dimensional boundary value problem was formulated by using the correlation between two and three dimensional potential functions. After the two dimensional solution was obtained, inverse transformations relating the two and three dimensional potential functions were used to obtain the solution of the original problem. Based on the preceding formulation, a routine procedure for calculating the normal stress and displacement on the plane of a symmetrical crack is illustrated. This procedure was used to evaluate the influence of linear strain hardening near a flat circular crack, the stress intensity factor for the toroidal crack, the Dugdale-Muskhelishvili model, for the toroidal crack, and the external notch. Dissert. Abstr.

N70-39338 IIT Research Inst., Chicago, Ill.
NONLINEAR ELASTIC BUCKLING OF OPEN CYLINDRICAL SHELLS
Peter Turula (Ph.D. Thesis) 1969 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-18607

The postbuckling behavior of a perfect shell subjected to uniform axial compression is studied. A technique is presented for tracing the equilibrium paths based on the linear eigenvalue solutions. The buckling of shells subjected to an axial compression, with imperfections due to loading eccentricity or initial deflections is examined. Equilibrium paths and deflection patterns for three different cases are presented. Both the critical load and the modes of buckling were found to agree with those obtained by the analytical solution based on linear theory. A technique for obtaining the buckling load of shells subjected to lateral gravity loading is illustrated. The lowest buckling load for open cylindrical shells subjected to uniform gravity load was found to be associated with a deflection pattern symmetrical about the transverse centerline but not symmetrical about the longitudinal centerline. Equilibrium paths and deflection patterns were obtained for a numerical example of a shell subjected to uniform load. Dissert. Abstr.

N70-39348# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
PROCEEDINGS OF THE 1969 COLUMN RESEARCH COUNCIL
1969 124 p refs Presented at the 1969 Ann. Meeting and Tech. Session Sponsored by NSF
Avail: NTIS

Abstracts and panel discussion proceedings from the annual technical session on structural members are presented. Problems related to stability and strength of metal compression members and other structures, design rules, and structural behavior are discussed. Special attention was given to column designs. E.H.W.

N70-39389# British Steel Corp., London (England). Plant Engineering and Energy Div.
STRENGTH AND RIGIDITY OF BOLTED BEAM TO COLUMN CONNECTIONS
J. R. Bailey 1970 30 p refs
(PB-191975; PE/E/2/70) Avail: NTIS CSCL 13M

Results of an experimental investigation into the structural behavior of a particular type of bolted connection is reported. A steel plate profile was welded to the end of a beam and bolted with high strength friction grip bolts to a column flange. In all, 13 assemblies were tested and attention was paid to the strength of the connection, its rotational capacity, and its ability to develop a plastic hinge, with all elements forming the joint reaching plasticity simultaneously. The design calculations for the test assemblies, conditions of loading, and method of instrumentation are followed by a brief description of each individual test with particular reference to its mode of failure. Graphs of load/deflection are shown, also photographs of the deformed connections. Author (USGRDR)

N70-39386# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.
VIBRATION ANALYSIS OF A FLOOR STRUCTURE
M. R. Patterson, G. W. Westley, J. A. Watts, and P. R. Coleman
10 Jun. 1970 202 p refs
(Contract W-7405-eng-26)
(CTC-30) Avail: NTIS

The analysis of steady-state, dynamic forces on a floor structure is summarized. Deviation of a solution which includes damping is included, along with descriptions of the programs which were written to perform the calculations. Two models of the floor are discussed; one includes only beam elements, and another has both beam and plate elements. NSA

N70-39549# Toronto Univ. (Ontario) Inst. for Aerospace Studies
SIMULATION OF RANDOM LOAD FATIGUE IN LABORATORY TESTING
T. J. Ravishankar Mar. 1970 124 p refs Sponsored by Natl. Res. Council
(AD-708327; UTIAS-29) Avail: NTIS CSCL 1/3

The methods used in laboratory simulation of random service load conditions, that lead in practice to fatigue failure e.g. aircraft structures, are reviewed. First, the inter-relation of the atmospheric turbulence with the resulting loads on the aircraft are discussed. Then follows an analysis and interpretation of service load histories and a review and comparison of the methods in use for simulating service load spectra of arbitrary and random load sequences. Both random loading, using discrete load levels or analogous random process testing, are discussed. Full scale testing is also reviewed. In appendices, stationary random processes and fewer spectral density functions an evaluation of probability distributions of RMS gust velocities and some damage theories are presented. Author (TAB)

N70-39652# New Hampshire Univ., Durham.
LONGITUDINAL FORCED VIBRATION OF VISCOELASTIC BARS WITH END MASS Special Report
D. M. Norris, Jr. and Wun-Chung Young (Combustion Eng., Inc.)
Hanover, N.H. CRREL Apr. 1070 30 p refs
(Contract DA-AMC-27-021-67-621)
(AD-707925; CRREL-SR-135) Avail: NTIS CSCL 20/11

A simple method is presented to measure the complex modulus of suitably rigid linear viscoelastic materials over the audiofrequency spectrum. The case is considered where one end of a rod of the material is driven harmonically and the complex displacement ratio is measured. The effect of a rigid end mass on the free end is accounted for. It is shown that, at specific frequencies near resonance, it is easy to obtain modulus data with standard equipment usually found in the vibration laboratory. An experimental program is described. Author (TAB)

N70-39693# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.

FINITE ELEMENT MODEL WITH APPLICATIONS TO BUILDINGS K-33 AND K-31

C. V. Smith (Ga. Inst. of Tech.) 1 Jun. 1970 109 p refs
(Contract W-7405-eng-26)
(CTC-29) Avail: NTIS

The theory of the finite element technique is first presented for any problem which can be described by a variational principle. The procedure is then applied to the beam and rectangular plate bending elements, with the mass and stiffness matrices and the loading vectors presented for each element. There is next a discussion of the structural modeling of the K-33 and K-31 building cell floor systems, which is necessary in order to utilize the finite elements as derived. This particular phase is in conjunction with the program for expansion of the gaseous diffusion plant capacity. Also a method is presented which can be used to reduce the size of the eigenvalue problems when calculating mode shapes and frequencies of free vibration. Author (NSA)

N70-39833# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A SIMPLE THEORY FOR SHOCK PROPAGATION IN HOMOGENEOUS MIXTURES

Peter J. Torvick May 1970 40 p
(AD-708134; AFIT-TR-70-3) Avail: NTIS CSCL 20/11

A Hugoniot pressure density relationship for homogeneous mixtures is calculated from the Hugoniot pressure density relationship of the constituents. The calculated values are found to be in reasonable agreement with available experimental data on mixtures of solids and porous materials. Author (TAB)

N70-39907*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLUTTER STUDIES TO DETERMINE NACELLE AERODYNAMIC EFFECTS ON A FAN-JET TRANSPORT MODEL FOR TWO MOUNT SYSTEMS AND TWO WIND TUNNELS

Moses G. Farmer Washington Sep. 1970 37 p refs
(NASA-TN-D-6003; L-7120) Avail: NTIS SCL 20K

Low-speed flutter studies of a dynamically and elastically scaled model of a large multijet transport airplane have been conducted primarily to determine the nacelle aerodynamic effects for high-bypass-ratio fan-jet engines. Data were obtained on a vertical rod mount in two wind tunnels and on a two-cable mount in one of the tunnels. The flutter response of the model was found to be dependent on nacelle aerodynamics, engine-pylon stiffness, mount-system–wind-tunnel configuration, and mass ratio. Author

N70-39927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF THE STABILITY OF CIRCULAR SOLID AND ANNULAR PLATES BY THE DISCRETE METHOD WITH UNIFORM AND NONUNIFORM BOUNDARY CONDITIONS

Yu. P. Petrov 27 May 1970 21 refs Transl. into ENGLISH from Samoletostr. Tekh. Vozdush. Flota (USSR), no. 4, 1966 p 39–51
(AD-708334; FTD-HC-23-435-69) Avail: NTIS CSCL 13/13

A previously published method is used for calculating the stability of circular and annular plates with homogeneous and nonhomogeneous boundary conditions. It is shown that the use of the discrete method for solving this stability problem with homogeneous boundary conditions gives results which coincide with analytical solutions. Consequently the method is applicable also for calculations with various types of nonhomogeneous boundary conditions if the circular and annular plates are divided by a sufficiently large number of straight lines. A system of differential matrix equations is derived which is solved to give a system of independent functions. Thus calculations by the discrete method employ the same type of operations in a cyclic scheme which is adaptable to programming on digital computers. TAB

N70-39929# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BEHAVIOR OF MATERIALS UNDER INTENSE DYNAMIC LOADS

L. P. Orlenko 15 May 1970 195 p refs Transl. into ENGLISH from Provedenie Materialov Pri Intensivnykh Dinami Cheskikh Nagruzkakh (Moscow), 1964 p 1–154
(AD-708350; FTD-HT-23-189-70) Avail: NTIS CSCL 20/11

Problems of impact compressibility in solid bodies and variations in the mechanical properties of materials under dynamic loading are discussed. Certain problems of stress-wave propagation in dense media, of dynamic deformation in thin-walled shells, and of modeling are examined during intense short-term loads. Author (TAB)

N70-39950# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CREEP IN STRUCTURAL ELEMENTS: SELECTED CHAPTERS

Yu. N. Rabotnov 20 Mar. 1970 644 p refs Transl. into ENGLISH from Polzuchest Elementov Konstrukt. (Moscow), 1966 p 1–516
(AD-708356; FTD-MT-24-448-69) Avail: NTIS HC $10.00/MF $0.65 CSCL 13/13

The book presents fundamentals of the theory of creep and its development during the past ten years as a new discipline in the mechanics of solids. Principal attention is paid to high-temperature creep of metals and alloys. The book furnishes essential empirical facts and uses them for writing kinetic equations of creep with respect, to various objects and various operational conditions. Furthermore, application of kinetic equations to calculate creep and stress rupture strength of columns, column systems, plates, shells, pipes, rotating discs, rotors, and other structural elements is studied. Problems of bulging and buckling of columns and shells under creep conditions are examined. A special chapter deals with the theory of viscoelasticity as applied to the investigation of creep in concrete and polymeric materials. TAB

N70-40046# Battelle Memorial Inst., Columbus, Ohio.

REVIEW OF THROUGH-WALL CRITICAL CRACK FORMULATIONS FOR PIPING AND CYLINDRICAL VESSELS

Robert J. Eiber, Willard A. Maxey, Arthur R. Duffy, and Thomas J. Atterbury May 1970 29 p refs
(Contract W-7405-eng-92)
(BMI-1883) Avail: NTIS

The formulations are evaluated by computing toughness values for the experimental data obtained in the AEC ductile pipe rupture study. It is concluded that the tough ductile materials appear to follow the behavior predicted by the flow stress equation. The flow stress relationship is the simplest of those examined and yet exhibits the least variation in toughness values. The other equations reviewed also provide accurate results but because of their complexity or empirical nature do not appear to be as desirable as the flow stress equation for the high-toughness material examined. Author (NSA)

N70-40050# Case Western Reserve Univ., Cleveland, Ohio. Union Carbide Corp., Cleveland, Ohio.
MINIMUM WEIGHT DESIGN OF STIFFENED FIBER COMPOSITE CYLINDERS Technical Report, Dec. 1967—Jun. 1969
Tung-Lai Chao (Ph.D. Thesis) Wright-Patterson AFB, Ohio AFML Sep. 1969 136 p refs Prepared for Union Carbide Corp., Cleveland
(Contract AF 33(615)-3110; ARPA Order 719)
(AD-708179; AFML-TR-69-251) Avail: NTIS CSCL 13/13

A structural synthesis capability for stiffened fiber composite cylindrical shells has been developed. The design variables are the configuration and material parameters. The material parameters considered are the fiber volume content and the ply orientations in the skin. Both longitudinal and circumferential stiffeners are assumed to have hat cross-sections. The instability loads of the heterogeneous anisotropic cylinder under combined axial, radial, and torsional loading are calculated with smeared stiffener theory. In the synthesis scheme, multiple load conditions on the cylinder are permissible. The optimal design problem is cast into a model of a nonlinear mathematical programming problem which is solved with the penalty function technique of Fiacco-McCormick. Since weight is independent of the ply orientations there exist alternative optima. Special modifications on the iteration procedure are made, so that the ply angles tend to move in such a way that the overall strength of the cylinder is improved. Numerical examples are discussed. Author (TAB)

N70-40088# Naval Civil Engineering Lab., Port Hueneme, Calif.
STRESS ANALYSIS OF A CONICAL ACRYLIC VIEWPORT Final Report, Apr. 1967—Apr. 1969
M. R. Snoey and J. E. Crawford Apr. 1970 70 p refs
(AD-708009; NCEL-TR-675) Avail: NTIS CSCL 11/9

This study was initiated to determine experimentally the structural response of a viewport design, determine the accuracy of the finite element method in predicting viewport behavior by comparing analytical to experimental results, and determine the effect, if any, of the flange surface finish on the structural behavior of the viewport using both experimental and analytical techniques. In the experimental phase, four, full-scale, conical acrylic viewports, with a nominal thickness-to-minor-diameter ratio of 0.5 and an included angle of 90 degrees, were strain-gaged and tested to 8,000 psi. In the analytical phase, the same viewport design was analyzed with a finite element computer program. The finite element results successfully bracketed the experimental results by assuming two extreme boundary conditions, fixed and free, at the viewport-flange interface. The fixed condition assumed an infinite coefficient of friction, and the free condition assumed zero friction. In addition, the finite element analysis provided complete internal stress distributions. All results indicated that viewports with this design exhibit both plugging and bending behavior and have two areas of high stress concentration, the center of the high-pressure face and the corner between the low-pressure face and the conical bearing surface. The analytical investigation indicated that the surface finish of the flange significantly affects the viewport stress distribution. Author (TAB)

N70-40122# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTACT PROBLEM OF THE THEORY OF ELASTICITY
I.Ya. Schtserman 15 May 1970 326 p Transl. into ENGLISH from Kontakt. Zadacha Teorii Uprugostii (Moscow), p 1-270
(AD-708357; FTD-MT-24-61-70) Avail: NTIS CSCL 20/11

The first chapter of the book is devoted to methods of the solution of fundamental equations of the contact problem. The second part contains, together with the classical investigations, an account of certain works of Soviet mathematicians on the two-dimentional contact problem of the theory of elasticity, including my works, part of which has been published for the first time. These include: a new formulation of the problem on the pressure of a stamp on an elastic half-plane, and the periodic contact problem. An attempt is made to calculate surface deformations, which up till now were not calculated in the theory of the contact problem. A number of new solutions are given for an axisymmetric contact problem of the theory of elasticity. The book should be regarded as a division of the mathematical theory of elasticity, since it is devoted to the solution of basic contact problems of the theory of elasticity. TAB

N70-40139# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
WAVE PROPAGATION IN TRANSVERSELY ISOTROPIC, LAYERED CYLINDERS
Henry E. Keck and Anthony E. Armenakas Mar. 1970 38 p refs
(Contract F44620-69-C-0072)
(AD-707862; PIBAL-70-9; AFOSR-70-0603TR) Avail: NTIS CSCL 13/13

The propagation of infinite trains of symmetric harmonic waves traveling in infinitely long, right circular cylindrical shells is investigated on the basis of the three-dimensional theory of elasticity. The shells are assumed made of three concentric, transversely isotropic cylinders each of different materials bonded perfectly at their interfaces. The frequency equation is established by representing the displacement field in each cylinder in terms of potential functions and satisfying the Navier equations of motion and the boundary and interface conditions of the cylinder. The frequency equation has been programmed for numerical evaluation on an IBM 7044/7094 DCS computer, and the influence of the mechanical properties of the layers on the frequencies of the first few modes is investigated. Author (TAB)

N70-40142# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.
STRESSES IN ORTHOTROPIC SHALLOW SHPERICAL SHELLS. PART 2: NUMERICAL RESULTS
Howard S. Kliger and Jack R. Vinson May 1970 30 p refs
(Grant AF-AFOSR-EM-9-07)
(AD-708498; TR-118-Pt-2) Avail: NTIS CSCL 13/13

The report contains the results obtained by digital computer stress analysis of loaded spherical shells. TAB

N70-40143# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.
STRESSES IN SHALLOW SPHERICAL SHELLS OF COMPOSITE MATERIALS SUBJECTED TO LOCALIZED LOADS
Howard S. Kliger and Jack R. Vinson Apr. 1970 199 p refs
(Grant AF-AFOSR-1780-69)
(AD-708481; AFOSR-70-1046TR) Avail: NTIS CSCL 13/13

Methods of analysis are developed to provide the stresses (both bending and membrane) and deformations in specially orthotropic shallow and nonshallow spherical shells of revolution subjected to localized loads at the apex. An accurate shell theory is employed including effects of circular orthotropy and transverse shear deformation. The governing equations are reduced to a single, second order complex differential equation. Solutions are obtained in terms of modified Bessel functions of non-integer order and complex argument. These functions are transformed into a set of infinite series, and upon proper non-dimensionalization, these series are shown to be uniformly and very rapidly convergent. Expressions are obtained for bending, membrane and shear stresses as well as lateral and inplane deflections everywhere in the shell. Comparisons and design curves are obtained for large variations in orthotropy and matrix shear properties which cover almost all known composite materials. Various boundary conditions, degrees of shallowness, and loading conditions are also systematically explored and reported. Author (TAB)

N70-40163# Virginia Polytechnic Inst., Blacksburg. Dept. of Engineering Mechanics.
THE BENDING DUGDALE MODEL
H. Gonzalez, Jr. and H. F. Brinson Aug. 1970 22 p refs
(Contract DAAF07-69-C-0444; Proj. Themis)
(VPI-E-70-14) Avail: NTIS

A theory is developed along theoretical lines to predict the extent of plastic yielding in front of a crack under transverse bending. The theory consists of superimposing several Muskelishvili type stress functions in the same way Dugdale's model was used in tension. Solutions for the size of the plastic zone are obtained on the surface and through the thickness. Author

N70-40172# Mechanical Technology, Inc., Latham, N.Y.
LITERATURE SEARCH AND CRITICAL REVIEW OF MECHANICAL FAILURE TECHNOLOGY Final Report
Marshall B. Peterson Jul. 1970 510 p refs
(Contract N00014-68-C-0242)
(AD-708764; MTI-70TR48) Avail: NTIS CSCL 14/4

A literature search was conducted and a critical bibliography prepared in the area of component failure technology. The objectives of the critical survey were: identification of critical components and problems in specific mechanical equipment; definition of failure modes and processes in components; determine the status of design techniques in order to predict failure; and determine the status of diagnostic techniques for predicting failure. Abstracts of the literature were acquired and subjected to critical review by specialists in order to assess the overall trends and significant developments that could be related to the failure of mechanical components. Summaries of the findings were then written in chapter form along with the pertinent abstracts and references. Author (TAB)

N70-40296# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.
COMPUTER PROGRAM FOR CALCULATING THE STRESSES IN SHALLOW SPHERICAL SHELLS OF COMPOSITE MATERIALS SUBJECTED TO LOCALIZED LOADS
Howard S. Kliger and Jack R. Vinson Apr. 1970 78 p ref
(Grants AF-AFOSR-1760-69; AF-AFOSR-EM-9-07)
(AD-708482; AFOSR-70-1047TR) Avail: NTIS CSCL 13/13

The computer program listed herein can be used to calculate the stresses and deflections in a specially orthotropic shallow or nonshallow spherical shell of revolution subjected to a normal concentrated load in the apex region of the shell. The effect of transverse shear deformation is included such that any ratio of elastic modulus/shear modulus is possible. The program is written in ASA FORTRAN IV compatible with the Scientific Data Systems 9300 computer. This report is directly related to, and must be used in conjunction with Report No. AFOSR 70-1046TR entitled Stresses in Shallow Spherical Shells of Composite Materials Subjected to Localized Loads. Author (TAB)

N70-40317# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
STACUSS 1: A DISCRETE-ELEMENT PROGRAM FOR THE STATIC ANALYSIS OF SINGLE-LAYER CURVED STIFFENED SHELLS SUBJECTED TO MECHANICAL AND THERMAL LOADS
James J. Kotanchik and Barbara A. Berg Dec. 1969 701 p refs
(Contract F04694-67-C-0039)
(AD-707838; ASRL-TR-146-9; SAMSO-TR-70-125) Avail: NTIS HC$10.00/MF$0.65 CSCL 20/11

A computer code STACUSS 1 for the small-deflection, linear-elastic, static, finite-element analysis of thin shells of revolution having structural and/or material asymmetries has been developed. The code utilizes recently-developed stiffness analyses for doubly-curved quadrilateral and conical triangular shell elements, and straight and curved stiffener elements. Isotropic and/or skew planar orthotropic temperature-independent material properties are accommodated. Mechanical and thermal loadings are taken into account. Also included in the code are (1) automatic mesh generation and plotting and (2) both in-core and out-of-core solution capabilities. Author (TAB)

N70-40327# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
PETROS 2: A NEW FINITE-DIFFERENCE METHOD AND PROGRAM FOR THE CALCULATION OF LARGE ELASTIC-PLASTIC DYNAMICALLY-INDUCED DEFORMATIONS OF GENERAL THIN SHELLS. APPENDIX D
Luigi Morino, John W. Leech, and Emmett A. Witmer Aberdeen Proving Ground, Md. Army Aberdeen Res. and Develop. Center Dec. 1969 221 p refs
(Contract DAAD05-68-C-0314)
(AD-708774; ASRL-TR-152-1-App-D; BRL-CR-12) Avail: NTIS CSCL 20/11

The equations of motion, strain-displacement relations, and the constitutive relations for a thin Kirchoff shell of arbitrary shape are derived in tensor notation. Taken into account are arbitrarily-large deformations, and material which exhibits elastic, elastic-plastic, strain hardening, and/or strain-rate sensitive behavior; also the shell may be subject to arbitrary initial velocities and/or transient external forces. The governing differential and algebraic equations then are recast into finite-difference form. These finite-difference equations have been employed to write a FORTRAN IV computer program called PETROS 2. Applications to illustrate various features of this formulation and program are presented. Included herein is the PETROS 2 program together with sample problem input and solution data. Subroutines which will handle shells having the following initial geometries are included: (1) cone, (2) cylinder, and (3) flat plate. The user may readily provide a similar initializing subroutine to permit analyzing a shell of some other initial shape. This report contains appendix D to the main report, AD-708 773. TAB

N70-40329*# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace and Applied Mechanics.
ASYMPTOTIC SOLUTION FOR PRESSURIZED NONCIRCULAR CYLINDERS WITH NONUNIFORM RINGS
Joseph E. Flaherty and William P. Vafakos Jun. 1970 84 p refs
(Contract Nonr-839(39) NGT-33-006-003)
(AD-707715; PIBAL-70-22; NASA-CR-113972) Avail: NTIS CSCL 20/K

An asymptotic expansion procedure is used to analyze hydrostatically loaded noncircular cylindrical shells. The asymptotic solution is combined with a solution for singly symmetric oval rings with variable cross-sectional properties to obtain the solution for pressurized noncircular cylinders with nonuniform rings. Numerical results are compared with existing solutions for doubly symmetric oval shells reinforced by uniform rings. The cross sections of these cylinders range from circular to ovals having a major-to-minor axis ratio of 1.3. Numerical results are also presented for oval cylinders reinforced by nonuniform oval rings. Cases of both singly and doubly symmetric rings are considered. Author (TAB)

N70-40359# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 2, NO. 2
Feb. 1970 21 p refs
(AD-700811) Avail: NTIS CSCL 20/11

Contents: Analytical methods; Design information; Modeling and simulation; Numerical techniques; Excitation; Phenomenology; Testing techniques; Mechanical elements; Metal working; Vibration isolation, and Shock isolation. TAB

N70-40370# Syracuse Univ. Research Corp., N.Y. Materials Science Lab.
IMPROVEMENT IN CRACK DETECTION BY ULTRASONIC PULSE-ECHO WITH LOW FREQUENCY EXCITATION
Semiannual Report, 28 Oct. 1969–27 Apr. 1970
John G. Sessler May 1970 32 p refs
(Contract N00140-70-C-0223)
(AD-708747; SAR-2) Avail: NTIS CSCL 14/2

A program of analytical and experimental research is being conducted to investigate the effect of stress fields on the ultrasonic energy reflected from thin flat cracks in solids. It has been established that the amplitude of ultrasonic signals reflected from a crack interface is decreased significantly when a compressive stress field is applied to the region of the crack. Also, within certain limitations, the amplitude is increased with increasing tensile stress. Thus, a crack in compression is more difficult to detect by pulse-echo than an unstressed crack, and the capability of detecting the crack is improved by application of tensile stress. Technically, it is possible to induce the stress required for improved detection by introducing low frequency sound excitation in the region of the crack. Efforts are being continued to further develop and to optimize this technique. Author (TAB)

N70-40381# Argonne National Lab., Ill.
ANALYTICAL MODELS FOR THE PREDICTION OF CREEP DEFORMATIONS IN HOLLOW, FINITE, RIGHT-CIRCULAR CYLINDERS
O. E. Widera and R. W. Weeks Jan. 1970 25 p refs
(Contract W-31-109-ENG-38)
(ANL-7630) Avail: NTIS

The analytical prediction of primary and secondary creep deformations in hollow, finite, right-circular cylinders loaded by axial tension or by compression, and subjected to internal and external pressure, and to arbitrary temperature gradients is discussed. Author (NSA)

N70-40384*# Battelle Memorial Inst., Columbus, Ohio.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF PLANE-STRESS FRACTURE OF 2024-T351 ALUMINUM ALLOY
C. E. Feddersen, F. A. Simonen, L. E. Hulbert, and W. S. Hyler Washington NASA Sep. 1970 78 p refs
(Contract NAS1-8522)
(NASA-CR-1678) Avail: NTIS CSCL 13M

A theoretical and experimental study was conducted on the plane-stress fracture behavior of precracked 2024-T3 aluminum alloy sheet and plate (–T351) panels. The influence of width, thickness, and crack-aspect ratio on the residual strength of centrally cracked panels was determined. An engineering analysis was also performed on the data utilizing several analytical and empirical fracture expressions. A more generalized data display and analysis technique was discussed. A theoretical analyses of plastic zones included both the boundary-point-least-square method on the Dugdale model, and a two-dimensional analysis by the finite-element method. Photoelastic determinations of the plastic-zone size and shape were used for validation. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N70-39054# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
REVIEW OF CONTACT ANGLE, WETTING AND ADHESION IN THREE PHASE SYSTEMS
O. C. Jones, Jr. Apr. 1970 29 p refs
(Contract W-31-109-eng-52)
(KAPL-3882) Avail: NTIS

A brief review of the literature on wetting and adhesion and some conclusions regarding their effects on the boiling process are presented. The various aspects of the interactions between phases at a triple interface are summarized. A 150 reference bibliography is included. Author

N70-39065# California Univ., Livermore. Lawrence Radiation Lab.
EQUATION OF STATE OF DETONATION PRODUCTS
H. C. Hornig, E. L. Lee, M. Finger, and J. E. Kurrle 1 Jun. 1970 9 p refs Presented at the 5th Intern. Symp. on Detonation, Pasadena, Calif., Aug. 1970 Submitted for publication Sponsored by AEC
(UCRL-72173; CONF-700803-5) Avail: NTIS

In previous papers a description of how isentropic expansions could be measured, and how an equation of state could be inferred if detonation velocity as a function of density were also known is given. The assumptions were: (1) that the fluid was essentially nonreactive once formed; (2) that the Gruneisen parameter was at most weakly temperature-dependent; and (3) that the C-J hypothesis holds. A comparison is made of calculated results with experiments on PETN with the purpose of testing the assumptions made in the previous analysis. Recent P sub CJ and detonation velocity measurements are reported for a density range 0.25 < rho 0 < 1.77. NSA

N70-39068 Rice Univ., Houston, Tex.
A CONTINUUM THEORY OF THE THERMODYNAMICS OF A RADIATING GAS
Kenneth Clayton Weston (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-19339

A mathematical model of a radiating continuum is investigated. The conservation of energy equation is augmented by a term expressing the divergence of a radiative heat flux in terms of a radiant intensity and a corresponding radiative stress tensor. A radiative stress tensor in terms of the intensity is also added to the balance of momentum. The Clausius–Duhem inequality is augmented by a term expressing the divergence of the radiant entropy flux in terms of an intensity of entropy radiation analogous to that used by Planck. An equation of radiative transfer is appended to the collection of field relations to describe the modification of the intensity of a ray due to absorption and emission processes. By requiring that constitutive equations expressing the character of the matter-radiation field satisfy the Clausius–Duhem inequality, relations are obtained for thermodynamic properties of the continuum. Dissert. Abstr.

N70-39084# Radio Corp. of America, Lancaster, Pa.
ADVANCED HEAT PIPE THERMIONIC TECHNOLOGY. TASK 1: DEVELOPMENT OF HIGH VOLTAGE MODULE
Final Technical Report, 1 May 1968–30 Sep. 1969
R. W. Longederff 30 Sep. 1969 47 p refs
(Contract AT(30-1)-3979)
(NYO-3979-3) Avail: NTIS

The design of a heat pipe-thermionic module concept capable of output potentials as high as 28 volts has been investigated. Technologies required for this module design have been developed beyond the state-of-the-art. An advanced Al2O3 casting technique was developed for the fabrication of the key insulated tri-layer assembly. Arc suppression coatings have been developed for the prevention of voltage arcs in the module due to potentials above the ionization potential of cesium. Fabrication and assembly techniques necessary for the logical development of the high voltage module concept have also been investigated. Heat pipe designs

capable of transferring the required thermal throughput for high voltage module concepts have also been investigated. Author (NSA)

N70-39158# Sandia Corp., Albuquerque, N.Mex.
OPTIMIZATION OF MULTI-LAYER INSULATOR SYSTEMS FOR TRANSIENT APPLICATIONS
H. C. Hardee May 1970 25 p
(SC-DR-70-321) Avail: NTIS

The problem of the design of an optimum transient insulator system of fixed thickness is considered in which the heat capacity of a heat sink is traded against a conventional insulator. The optimum thickness of insulator and heat sink, determined by laborious conventional means, is compared with two approximate techniques which allow rapid estimates of the proper ratio of heat sink and insulator. One approximate technique is based on minimum eigenvalues, and the other is based on the idea of an effective diffusivity. Results are shown for both a two layer and a three layer example. Author

N70-39161# Los Alamos Scientific Lab., N.Mex.
EQUATION OF STATE FOR SHOCKED COPPER FOAM
Charles L. Mader 10 Feb. 1970 5 p refs
(Contract W-7405-eng-36)
(LA-4381) Avail: NTIS

The experimentally observed behavior of systems of high-explosive, low-density copper foam in contact with uranium, copper, tin, aluminum, magnesium, Plexiglass, wax, methyl pentene, cherry wood, and air are numerically reproduced. Author

N70-39182# California Univ., Livermore. Lawrence Radiation Lab.
THERMAL DECOMPOSITION OF HIGH EXPLOSIVES AT STATIC PRESSURES 10 – 50 KILOBARS
E. L. Lee, R. H. Sanborn, and H. D. Stromberg 1 May 1970 7 p refs Presented at the 5th Symp. on Detonation, Pasadena, Calif., 18 – 21 Aug. 1970 Submitted for publication Sponsored by AEC
(UCRL-72172; CONF-700803-3) Avail: NTIS

The time to explosion of five high explosives (TNT, PETN, HMX, nitromethane, and 2,2-dinitropropane) under static pressures up to 50 kbar at various temperatures was measured. The behavior of PETN and HMX indicates the suppression of gaseous intermediates by the high pressure and a corresponding reduction in the rate of decomposition. This is supported by observation that pressure does not affect TNT decomposition where it is known that the formation of solid intermediates is the important step. Nitromethane, on the other hand, exhibits an increase in rate with increase in pressure. Measurements of the infrared spectra of nitromethane at pressures up to 50 kbar reveal increasing intensity of the methyl group vibrations and a consequent shift in dipole moment related to associations in the liquid phase. Another nitro aliphatic with a different type of structure, 2,2-dinitropropane, exhibits a normal decrease in rate at high pressure. NSA

N70-39250 Rice Univ., Houston, Tex.
A STUDY OF THEORIES OF MIXTURES WITH SEVERAL TEMPERATURES
Donald Joaquin Garcia (Ph.D. Thesis) 1969 62 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-19290

The effects of a distinct temperature field associated with each constituent in a mixture of rigid heat conductors is investigated. A convexity condition on the Massieu function is proposed and it is shown that this condition severely restricts the conditions under which the constituents can have a distinct temperature. A linear isotropic theory of heat condition is formulated. The relaxation of temperatures to a common value in the spatial independent problem and the time independent problem are investigated. The effects of multiple temperatures in a mixture of viscoelastic materials of the Voight type with heat conduction and diffusion are investigated. The restrictions imposed on the constitutive equations by the entropy inequality are explored. A linear theory for a mixture undergoing small temperature changes, small deformations, and small departures from thermodynamic equilibrium is formulated. Dissert. Abstr.

N70-39325# Scientific Translation Service, Ann Arbor, Mich.
NEW THEORY OF HEAT TRANSFER EXPERIMENTS [NOUVELLE THEORIE DES EXPERIMENTATIONS DE TRANSFERT DE LA CHALEUR]
C. I. Staicu Jun. 1970 15 p refs Transl. into ENGLISH of ICENERG, Bucharest, Conf. Paper MT 1.8 Presented at the 4th Intern. Heat Transfer Conf., Versailles, France, 29 Aug. – 5 Sep. 1970 Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-829; Conf-700805-2; MT-1.8) Avail: NTIS

General dimensional analysis, law of minimum integer positive values, and progressive homogeneity law are presented. The homogeneous method of fundamental magnitudes and the experimental theory formed the general dimensional analysis. Experiments were originated and interpreted, so that they established the magnitudes distributed on both sides of the equal sign and the value of the numerical factor. Author

N70-39378*# Aerotherm Corp., Mountain View, Calif.
ADVANCED METHODS FOR CALCULATING RADIATION TRANSPORT IN ABLATION-PRODUCT CONTAMINATED BOUNDARY LAYERS
William E. Nicolet Washington NASA Sep. 1970 90 p refs
(Contract NAS1-9399)
(NASA-CR-1656; Rept-69-61) Avail: NTIS CSCL 20M

A prediction method is described which can be used to obtain nongrey radiative fluxes or intensities at any point within a plane-parallel slab (for the flux calculation) or at any point on a ray (for the intensity calculation). The method was developed for the study of radiation heating phenomena in the mass injected, hypersonic boundary layer environment; however, it is not limited to such studies. The radiative properties model assumes local thermodynamic equilibrium and considers the continuum transitions, molecular bands, and atomic lines of the species of the C-H-O-N elemental system. The bandless model for the molecular bands is the only approximation which is an integral part of the method. Any of the other aspects of the properties model can be made to include as much (or little) detail as desired, allowing trade-offs to be made between accuracy and computational effort. Author

N70-39427*# Stanford Univ., Calif. Thermosciences Div.
THE EFFECT OF FREE-STREAM TURBULENCE ON HEAT TRANSFER TO A STRONGLY ACCELERATED TURBULENT BOUNDARY LAYER
D. W. Kearney, W. M. Kays, R. J. Moffat, and R. J. Loyd Feb. 1970 15 p refs
(Grants NGR-05-020-134; NSF GK-2201)
(NASA-CR-113590; SU-HMT-9) Avail: NTIS CSCL 20M

Heat transfer experiments were carried out on a turbulent boundary layer subjected to a strongly accelerated free-stream ($K = 0.0000025$), with initial turbulence intensity levels of 0.7 percent, and 3.9 percent. Stanton number, mean temperature, velocity profiles, and turbulence intensity profiles were measured along the accelerated region. The turbulence intensity profiles indicate that at the end of the accelerated region both cases still exhibit the characteristic shapes of fully turbulent layers, though the level of the turbulence is notably reduced. Additionally, the heat transfer data for the two cases are identical within the uncertainty of the experimental data, displaying virtually no effect of the free-stream turbulence intensity. Theoretical predictions obtained by solution of the boundary layer equations, taking into account the boundary conditions on the turbulent energy corresponding to the two cases, agree with the results. Author

N70-39446*# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.

AN APPROXIMATE THEORY OF IMPERFECT MODELING WITH APPLICATION TO THE THERMAL MODELING OF SPACECRAFTS Final Report

B. T. Chao and M. N. Huang Jul. 1970 153 p Prepared for JPL

(Contracts NAS7-100; JPL-952593)

(NASA-CR-113597) Avail: NTIS CSCL 22B

A computer experiment was carried out for the prediction of the transient and steady state thermal behavior of a hypothetical spacecraft using perfect, as well as imperfect, models. The hypothetical spacecraft has major radiative and conductive heat flow paths that crudely simulate those of the '64 Mariner family of space vehicles. Errors in the conductance and capacitance parameters of up to 25 percent existed in the imperfect models. Extensive temperature data were obtained for the various components of the spacecraft when it was subjected to a sudden heating, due to its exposure to the sun's radiation and the power dissipation within the bus, followed by its attaining the steady state and the subsequent cooling as a result of removing the sun's heat. Data were also acquired under the condition of a cyclically varying thermal environment. Generally speaking, errors of up to 10, 20, and 30 R, originally present in the data of the imperfect models, were reduced to less than 3 R after correction according to the theory under investigation. Author

N70-39457*# Illinois Univ., Urbana.

RADIANT HEAT EXCHANGE IN A SPACE ENVIRONMENT Scientific Technical Report, 1 Aug. 1969 - 31 Jan. 1970

R. G. Hering, T. F. Smith, and W. D. Fischer 31 Jan. 1970 33 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951661)

(NASA-CR-113549; STR-6) Avail: NTIS CSCL 20M

Continuing research is reported in a program aimed at developing analytical methods for predicting radiant heat transfer and temperature of engineering surfaces in a space environment. The results and conclusions drawn from previous research are updated and current projects are outlined. An analysis is presented on a study of spectral surface property effects on radiant heat transfer between radiatively interacting surfaces. D.L.G.

N70-39458*# Illinois Univ., Urbana.

RADIANT HEAT EXCHANGE IN A SPACE ENVIRONMENT Scientific Technical Report, 1 Feb. - 31 Jul. 1970

R. G. Hering, T. F. Smith, and W. D. Fischer 31 Jul. 1970 49 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951661)

(NASA-CR-113548; STR-7) Avail: NTIS CSCL 20M

Research is reported in a continuing program to develop analytical methods for predicting radiant heat transfer and temperature of engineering surfaces in a space environment. The results and conclusions drawn from previous research are updated and current projects are outlined. In addition, the design of a study to establish the relative importance of directional and spectral dependence of real surface radiative properties on radiant heat transfer is briefly discussed. D.L.G.

N70-39659*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

SUMMARY OF COMBUSTION INSTABILITY RESEARCH, 1 AUGUST 1969 - 31 JULY 1970

B. T. Zinn, W. C. Strahle, E. A. Powell, and M. E. Lores Aug. 1970 39 p refs

(Grant NGR-11-002-083)

(NASA-CR-113602; Rept-70-5) Avail: NTIS CSCL 20D

The status and summary of recent results obtained for predicting the nonlinear behavior of unstable liquid propellant rocket motors are described. The studies under consideration include: (1) determination of the nonlinear behavior of unstable rockets with the aid of a second order theory; (2) the development of a third order theory; (3) investigation of nonlinear axial instability in liquid rockets; and (4) investigation of the behavior of the unsteady combustion response function. Author

N70-39714*# California Univ., Livermore. Lawrence Radiation Lab.

NUMERICAL ANALYSIS OF A DIVERGING SHOCK WAVE IN PLEXIGLAS CYLINDERS

Minao Kamegai and John Erkman (NOL, White Oak, Md.) 8 May 1970 8 p refs Presented at 5th Symp. on Detonation, Pasadena, Calif., 18-21 Aug. 1970. Supported in part by AEC

(UCRL-72450; CONF-700803-2) Avail: NTIS

The Mie-Gruneisen type equation of state was derived for Plexiglas from the experimentally determined relation between shock velocity and particle velocity. The equation was used in the two dimensional elastic-plastic code, HEMP, to study a diverging shock wave in a Plexiglas cylinder. The agreement between the computation and experimental data is generally good. The curvature of the shock front in Plexiglas is simulated satisfactorily. Calculated stress versus time curves for different lengths of Plexiglas give some insight into the mechanics of gap testing of explosives. Author

N70-39715*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.

SIMULATION OF THE DYNAMICAL LOADING OF PMMA IN THE NOL REGULAR CARD GAP TEST

E. G. Fisher, R. G. Johnson, and R. F. Paulson 2 Apr. 1970 131 p refs

(Contract N60921-69-M-2003)

(AD-708014; NOLTR-69-209; Rept-12135-FRI) Avail: NTIS CSCL 19/4

Results are presented of a computer simulation of the flow induced in a Plexiglass PMMA rod by a charge of tetryl. The charge and the rod are the standard donor and attenuator of the Naval Ordnance Laboratory Large Scale Gap Test LSGT. The computations provide a better understanding of the flow and hence of phenomena which have been observed in PMMA rods during calibration studies of the LSGT. They also give data on the shape and duration of the pressure pulse in the PMMA which is transmitted into the acceptor explosive in the LSGT. Such data are needed in the study of shock sensitivity of explosives. Author (TAB)

N70-39743*# Syracuse Univ., N.Y. Dept. of Physics.

RELATIVISTIC THERMODYNAMICS

Victor H. Hamity (Univ. Nacl. de Cordoba, Arg.) Jun. 1970 50 p refs

(Grant AF-AFOSR-1654-69)

(AD-708137; AFOSR-70-1806TR) Avail: NTIS CSCL 20/10

The report shows that a generalized formulation of statistical mechanics provides a unified logical basis for the construction of a manifestly covariant theory of relativistic thermodynamics in contrast to heuristic approaches, such as the original theory by Planck and Einstein, and more recent ones by Ott and Moller. The generalized formalism is applied to discuss the relativistic thermodynamics of black body radiation, including such processes as the absorption and reflection of a light beam as well as the adiabatic cooling of cosmic black body radiation in Milnes model of the universe. The measurement of the temperature of a light beam is also discussed. Author (TAB)

N70-39944*# Sandia Corp., Albuquerque, N.Mex.

SELECTION OF THE OPTIMAL RADIUS OF BLUNTNESS OF AN AXISYMMETRIC BODY, TAKING RADIATION OF THE SURFACE INTO CONSIDERATION

V. Ya. Borovoy 25 May 1970 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. zhidk. gaza (USSR), no. 4, 1968 p 193-196

(SC-T-70-4018) Avail: NTIS

The problem of determining, under heat transfer conditions, the optimal bluntness of an axisymmetric body in a supersonic gas flow was studied at zero angle of attack, taking into account radiation from the surface of the body. The results of computing the optimal radius of bluntness of a 10 degree half-angle cone at different values of the ratio between heat flux at the characteristic point and the radiation heat flux are cited. It is shown that, for small values of this ratio, the small bluntness values are the optimal ones. Author (NSA)

N70-39945*# Translation Consultants, Ltd., Arlington, Va.
THE OCCURRENCE OF DETONATION IN A NONUNIFORMLY HEATED GAS [O VOZNIKNOVENII DETONATSII V NERAVNOMERNO NAGREBOM GAZE]
Ya. B. Zeldovich et al Washington NASA Sep. 1970 15 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. Tekh. Fiz. (USSR), no. 2, 1970 p 76–84
(Contract NASw-2038)
(NASA-TT-F-13220) Avail: NTIS CSCL 21B

A theoretical investigation of the propagation of a detonation wave is made. The problem of the occurrence of detonation in a nonuniformly heated gas capable of a chemical reaction is solved numerically. The three possible reaction flow conditions are developed. Author

N70-39985# Denver Research Inst., Colo. Mechanics Div.
STUDY OF ILLUMINATING FLAMES FROM SOLID REACTANTS Final Report, 1 Aug. 1968–1 Apr. 1970
Robert M. Blunt 1 Jun. 1970 82 p refs
(Contract N00164-69-C-0036)
(AD-707720; NAD-CR-RDTR-77) Avail: NTIS CSCL 9/1

The report summarizes and describes an extensive spectroradiometric study of the radiation produced in the 0.43 micron - 1.17 micron region by flames resulting from the combustion of magnesium with the alkali and alkaline earth nitrates and with sodium perchlorate at an ambient air pressure of 630 torr. Both fuel rich and stoichiometric compositions were studied. Additional studies were made of the influence of the ambient air pressure on the combustion of a 57% Mg, 38% $NaNO_3$, 5% Laminac composition at ambient air pressure ranging from 760 torr to 1 torr to determine quantitatively the decline in output. Author (TAB)

N70-40193# California Univ., Livermore. Lawrence Radiation Lab.
METAL ACCELERATION BY COMPOSITE EXPLOSIVES
M. Finger, H. C. Hornig, E. L. Lee, and J. W. Kury 14 May 1970 11 p refs Presented at the 5th Symp. on Detonation, Pasadena, Calif., 18-21 Aug. 1970 Submitted for publication Sponsored by AEC
(UCRL-72171; Conf-700803-1) Avail: NTIS

The metal accelerating ability of plastic-bonded explosives (PBX) containing aluminum, inorganic oxidizers, or mixtures of the two has been investigated. These composite formulations were prepared by replacing a portion of the HMX in conventional PBX's with aluminum ammonium perchlorate, or potassium perchlorate. Thermodynamic-hydrodynamic code calculations were used to model extremes in performance for these systems. Comparison with experimental results made it possible to infer rates and extent of reactions of the additives. Author

N70-40229*# John Carroll Univ., University Heights, Ohio.
BEHAVIOR OF FLUIDS IN THE VICINITY OF THE CRITICAL POINT
K. Fritsch and E. F. Carome Washington NASA Sep. 1970 75 p refs
(Grant NGR-36-006-002)
(NASA-CR-1670) Avail: NTIS CSCL 20D

Results of recent analyses of critical point behavior of single component fluids are presented. Acoustical and optical techniques for studying such behavior are discussed and experimental systems developed for this work are described. Results of sound velocity and absorption measurements in CO_2, and SF_6 in the kilohertz and megahertz range and limited light scattering measurements in SF_6 are presented. Low frequency sound velocity measurements in CO_2 indicate that the adiabatic compressibility and the specific heat at constant volume may diverge logarithmically as the critical point is approached along the critical isochore. Author

N70-40246# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
A COMPARISON OF FOUR SIMPLE CALCULATION METHODS FOR THE COMPRESSIBLE TURBULENT BOUNDARY LAYER ON A FLAT PLATE
Blaine Pearce 16 Mar. 1970 53 p refs
(Contract F04701-69-C-0066)
(AD-708147; TOR-0066(5758-02)-3) Avail: NTIS CSCL 22/2

Four simple calculation procedures for estimating the heat transfer and skin friction for a turbulent compressible boundary layer on a smooth flat plate are compared with experimental data in flows approximating the boundary layer edge conditions on the bottom surface of the Space Transportation System orbital vehicle. The methods compared are Eckerts reference enthalpy, the adiabatic wall reference enthalpy, Spalding and Chi, and the reference density-viscosity-method. For the data used in the comparison the most consistently accurate prediction of the skin friction is given by Spalding and Chis method. This method also gives the best estimates of the heat transfer when used with Von Karmans equation for the Reynolds analogy factor. Author (TAB)

N70-40372# Aerotherm Corp., Palo Alto, Calif.
EVALUATION OF THERMODYNAMIC AND TRANSPORT PROPERTIES FOR USE IN THE BLIMP NONSIMILAR MULTICOMPONENT BOUNDARY-LAYER PROGRAM
Christian Deblaye and Eugene P. Bartlett Albuquerque, N.Mex. Sandia Corp Jul. 1969 78 p refs Prepared for Sandia Corp.
(SC-CR-69-3271) Avail: NTIS

The thermodynamic and transport property models used in the BLIMP (boundary layer integral matrix procedure) nonsimilar multicomponent chemically-reacting boundary-layer program are summarized, and species data recommended for use in the C-H-O-N-electron elemental system are presented. These models and species data are then used to generate air thermodynamic and transport properties, and the results are compared to data from other sources. The agreement is favorable. Author

N70-40376# Oregon State Univ., Corvallis. Dept. of Mechanical Engineering.
NATURAL CONVECTION HEAT TRANSFER IN LIQUID METALS Progress Report, 1 Apr.–31 Dec. 1969
James R. Welty 31 Dec. 1969 6 p
(Contract AT(45-1)-2094)
(RLO-2094-1) Avail: NTIS

Continuing research is reported in a program to obtain basic information regarding natural convection heat transfer in low Prandtl number fluids. Initial investigation involved that of a vertical surface in liquid mercury with another parallel vertical surface adjacent to it at varying distances. Separate discussions are presented of accomplishments obtained experimentally and analytically using a numerical approach. D.L.G.

N70-40389# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
COMBUSTION CHARACTERISTICS OF BI-PHASE ROCKETS
Richard R. Weiss and John R. Osborne May 1970 128 p refs
(Grant AF-AFOSR-1420-68)
(AD-706890; AFOSR-70-0768TR) Avail: NTIS CSCL 21/9

The report describes an experimental and analytical

investigation conducted for evaluating the influence of combustion chamber pressure and propellant temperature effects on liquid rocket combustion dynamics. The experimental program was conducted with a small-scale rocket engine thrust chamber assembly using bi-phase propellants. Air was used as the oxidizer and normal heptane was used as the fuel. Chamber pressures investigated ranged from 250 to 1000 psia; values below the critical pressure of the fuel to ones considerably above it. The values for the initial temperature of the injected fuel ranged from 520 degrees R to 910 degrees R. It was found that increasing the chamber pressure has a strong stabilizing effect, increasing the initial fuel temperature has a slight destabilizing effect and decreasing the drop size has strong destabilizing effect. Two combustion models were used for obtaining analytical predictions of the stability behavior for correlating the experimental results and the the determining the validity of the models. Author (TAB)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N70-39254# Royal Aircraft Establishment, Farnsborough (England).
DEFENCE RESEARCH ABSTRACTS. UNCLASSIFIED ISSUE 68/69-4 [FROE FOERSVARS FORSKNINGS REFERAT. OEPPEN DEL]
Apr. 1970 39 p refs Transl. into ENGLISH from Swedish Rept. (RAE-LIB-TRANS-1411) Avail: NTIS

Selected abstracts are reported on systems analyses, nuclear reactions, chemical and biological warfare, conventional warfare, applied physics, teletechniques, biotechnology, military psychology, and psychological defense. R.B.

N70-39297*# National Aeronautics and Space Administration, Washington, D.C.
METHODS FOR NASA-UNIVERSITY RELATIONSHIPS
Jul. 1970 35 p refs
(NASA-TM-X-52885) Avail: NTIS CSCL 05A

A resume or catalog is presented with commentary on the methods that NASA and its centers now use or reasonably could use in relationships with universities. It is intended to assist the Assistant Administrator for University Affairs in his support of university programs; it should assist the Office of University Affairs in administering university programs for the agency; and it should assist the centers in initiating and managing university programs. Each type of activity, or relationship, is described briefly and its purpose stated; the basic authority is listed and an example cited. Some background history is given, and the nature and extent of use of the activity in NASA is illustrated. Finally, for each type of activity, or relationship, a consensus is offered on the general value, advantages, and disadvantages of the activity. Author

N70-39317# Arizona Univ., Tucson.
LEGISLATIVE PULSE REGARDING AIR POLLUTION
Ken Cardella *In its* Proc. of Air Pollution Control Seminar 13 Feb. 1970 p 77-90 (See N70-39313 22-04)
Avail: NTIS

Legislative efforts in the area of anti-pollution are discussed, along with associated problems and possible solutions. The definition of air pollution is explained, and county advisory councils and hearing boards, possible rules and regulations, laws on violations, and variances are considered. P.A.B.

N70-39354# Centralny Institut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 13, NO. 7 [NUKLEONIKA, TOM 13, NR. 7]
[1968] 102 p refs Transl. into ENGLISH from Nukleonika (Poland), v. 13, no. 7, 1968 p 719-826 Supported by AEC and NSF
(AEC-tr-6931/7; TT-68-50011/7) Avail: NTIS

The research on hot plasma physics in the Institute of Nuclear Research, Swierk is presented. The experimental arrangements with the diagnostic methods, and general technical problems are described. The role of collimators in time-of-flight neutron diffractometry is discussed, and the determination of distribution coefficients and stability constants of chelates of nitrogen and uranium oxide are presented. Isotopic studies of solid phase movement in fluidized beds are included. F.O.S.

N70-39405# Joint Publications Research Service, Washington, D.C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 236
27 Aug. 1970 38 p refs Transl. into ENGLISH from various Sino-Soviet bloc publications
(JPRS-51256) Avail: NTIS

CONTENTS:
1. ASTRONOMY p 1-4 refs (See N70-39406 22-30)
2. METEOROLOGY p 5-10 refs (See N70-39407 22-20)
3. OCEANOGRAPHY p 11-18 refs (See N70-39408 22-13)
4. TERRESTRIAL GEOPHYSICS p 19-25 refs (See N70-39409 22-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 26-31 refs (See N70-39410 22-13)

N70-39411*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED DEVELOPMENT Semiannual Review, 1 Jan.-30 Jun. 1970
31 Aug. 1970 250 p refs Sponsored by NASA
(NASA-CR-86437; JPL-701-90) Avail: NTIS CSCL 22B

CONTENTS:
1. SPACE APPLICATIONS SRT p 1-4 (See N70-39412 22-14)
2. COMMUNICATIONS SRT p 5-30 refs (See N70-39413 22-07)
3. LAUNCH VEHICLE SRT p 31-43 (See N70-39414 22-31)
4. PLANETARY EXPLORATION SRT: ADVANCED TECHNICAL DEVELOPMENT p 43-209 (See N70-39415 22-28)
5. PLANETARY QUARANTINE AND BACK CONTAMINATION p 211-238 (See N70-39416 22-04)

N70-39452# Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Feb. 1970 37 p refs
Avail: NTIS

CONTENTS:
1. THE ENERGETICS OF ELECTRON IMPACT REACTIONS F. E. Saalfeld p 1-7 refs (See N70-39453 22-14)
2. THE SOLAR CYCLE VARIATION OF SOFT X-RAY EMISSION R. W. Kreplin p 8-17 refs (See N70-39454 22-29)
3. PROBLEM NOTES AND SUPPORTING TECHNIQUES p 18-36 refs (See N70-39455 22-34)

N70-39455# Naval Research Lab., Washington, D.C.
PROBLEM NOTES AND SUPPORTING TECHNIQUES
In its Rept. of NRL Progr. Feb. 1970 p 18-36 refs (See

N70-39452 22-34)
Avail: NTIS

Technological advancements in research and development projects are reported. Specific areas of achievement include: (1) nuclear submarine atmosphere purification; (2) an extension of Ghazala's method to incompletely specified multiple-output functions; (3) research in functions of a complex variable; (4) laser interaction with a sapphire-nickel interface; (5) demonstration of improved radiation embrittlement resistance in pressure vessel steel; (6) determination of solid-liquid energies in metals; (7) fractural toughness of structural metals; (8) shape of a cable towed in a circular path; (9) ionospheric ray tracing for earth backscatter simulation on an east-west path during sunrise; and (10) analysis of X-ray emission data by means of the valence bond method. D.L.G.

N70-39516# Pennsylvania Univ., Philadelphia.
QUERY FORMULATION AND ENCODING Status Report. Dec. 1967 – Apr. 1970
Margaret Milne and Paul R. Weinberg Edgewood Arsenal Edgewood, Md. 30 Apr. 1970 186 p refs
(Contract DAAA15-69-C-0140)
(AD-869857) Avail: NTIS CSCL 5/2

The document is intended to serve as a user's guide in formulating and encoding queries addressed to the model operational CIDS. The report summarizes the overall process of retrieval from a user's standpoint, and discusses the efficient use of each of the various components of the search system. Numerous illustrations of queries encoded on the standard coding form are provided, along with explanations of the strategy employed in each search. The command language for inputting and processing queries from the teletype is included as an appendix. Author (TAB)

N70-39642*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED DEVELOPMENT, VOLUME 2 Semiannual Review, 1 Jul. – 31 Dec. 1968
15 Feb. 1970 732 p refs
(Contract NAS7-100)
(NASA-CR-86438; JPL-701-23) Copyright. Avail: NTIS HC $10.00/MF $0.65 CSCL 05A

CONTENTS:

1. SPACE POWER AND ELECTRIC PROPULSION SYSTEM SRT p 1 – 217 refs (See N70-39643 22-03)
2. SPACE VEHICLE SYSTEMS SRT p 219 – 315 refs (See N70-39644 22-31)
3. ELECTRONICS SYSTEMS SRT p 317 – 462 refs (See N70-39645 22-09)
4. HUMAN FACTORS SYSTEMS SRT p 463 – 468 (See N70-39646 22-05)
5. CHEMICAL PROPULSION p 469 – 550 refs (See N70-39647 22-28)
6. CHEMICAL ROCKET EXPERIMENTAL ENGINEERING p 551 – 596 (See N70-39648 22-28)
7. RESEARCH PROGRAM SRT p 597 – 713 refs (See N70-39649 22-34)

N70-39649*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH PROGRAM SRT
In its Res. and Advanced Develop., Vol. 2 15 Feb. 1970 p 597 – 713 refs (See N70-39642 22-34)
Copyright. Avail: NTIS HC $10.00/MF $0.65 CSCL 05A

Research progress is reported on fluid and electro-physics, materials, and applied mathematics pertinent to space flight and technology. The studies include heat transfer, thermionics, cryogenics, semiconductors, plasma sources, properties of polymers, and flight and celestial mechanics. R.B.

N70-39699# Illinois Univ., Urbana. Coordinated Science Lab.
A RELATIONAL STRUCTURE FOR DOCUMENT RETRIEVAL IN CODING THEORY
Nicholas Matthew Esser, Jr. May 1970 42 p refs
(Contracts DAAB07-67-C-0199; OE-C-1-7-071213-4557; Grant NSF GK-2339)
(AD-707686; R-469; UILU-ENG-70-214) Avail: NTIS CSCL 5/2

The paper defines a relational data structure designed for a document retrieval system in coding theory. The structure consists of a hierarchy tree structure and a functional structure known as a lateral link. The retrieval functions of the lateral links are to bring up the possibility of ambiguity, suggest related search topics, and propose the elimination of irrelevant topics. An outline of the application of this data base to a retrieval system is presented, along with suggestions for further studies leading to implementation of such a system. Author (TAB)

N70-39717# Commerce Dept., Washington, D.C. Office of the Secretary.
THE ROLE OF SCIENTISTS AND ENGINEERS IN DEVELOPING PUBLIC POLICY Address by Assistant Secretary of Commerce for Science and Technology
Myron Tribus 3 Apr. 1970 15 p Presented at the Eastern Regional Conf. on the Appl. of Sci. and Technol. to Public Programs, Boston, 3 Apr. 1970; sponsored by the New Engl. Econ. Res. Found.
Avail: Issuing Activity

The need for engineers with humanist background and outlook, and the education of engineers in the area of social conscience and responsibility are discussed. It is felt that conflict arises at the interface between technology and society and that there are too few people who can function at this interface. Studies are quoted which indicate the engineer considers himself a highly trained technical person capable of producing what he is told to do because of his specialized training, but does not consider himself as a guardian of society and the environment and taking action in human problem fields. It is suggested that humanist courses be taught to the student engineer, not as given to liberal arts students, but geared specifically so as to involve the student emotionally and have him participate as an engineer. What the young student engineer requires is an opportunity to grapple with total problems, such as urban and environmental problems, and to be involved in creative experiences. N.E.N.

N70-39737# Office of Naval Research, London (England).
ISRAEL ANNUAL CONFERENCE ON AVIATION AND ASTRONAUTICS (12th)
I. Estermann 11 May 1970 11 p
(AD-703726; ONRL-C-15-70) Avail: NTIS CSCL 1/2

Topics discussed in 26 papers were centered around aircraft development, aerodynamics and fluid dynamics, propulsion, structures, and flight mechanics and control. An exhibition showed models of two locally produced aircraft types and accessories, as well as exhibits by foreign firms. Author (TAB)

N70-39787*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-63, VOLUME 3 FOR THE PERIOD 1 APRIL – 31 MAY 1970. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
30 Jun. 1970 252 p refs
(Contract NAS7-100)
(NASA-CR-86436; JPL-SPS-37-63-Vol-3) Copyright. Avail: NTIS CSCL 05A

CONTENTS:

1. SPACE SCIENCES DIVISION p 1 – 22 refs (See N70-39788 22-06)
2. TELECOMMUNICATIONS DIVISION p 23 – 79 refs (See N70-39789 22-07)

PUBLIC COLLECTIONS OF NASA DOCUMENTS

3. GUIDANCE AND CONTROL DIVISION p 80–123 refs (See N70-39790 22-21)
4. ENGINEERING MECHANICS DIVISION p 124–149 refs (See N70-39791 22-09)
5. ASTRIONICS DIVISION p 150–160 refs (See N70-39792 22-08)
6. ENVIRONMENTAL SCIENCES DIVISION p 161–166 refs (See N70-39793 22-11)
7. PROPULSION DIVISION p 167–235 refs (See N70-39794 22-27)
8. MISSION ANALYSIS DIVISION p 236–239 refs (See N70-39795 22-30)

N70-39811# Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON EASTERN EUROPE SCIENTIFIC AFFAIRS, NO. 131
16 Sep. 1970 31 p refs Transl. into ENGLISH from various Bulg., Ger., and Rumanian Publ.
(JPRS-51381) Avail: NTIS

CONTENTS:
1. PURIFICATION OF OIL-POLLUTED WASTE WATER URGED p 2–7 refs (See N70-39812 22-15)
2. NEED FOR GREAT ADVANCES IN GEODETIC WORK H. Peshel p 8–16 (See N70-39813 22-13)
3. ORAL TYPHOID VACCINE DESCRIBED Docent N. Nestorescu, S. Gh. Filipescu, I. Ciocirlie, and I. Iordachescu p 17–21 refs
4. VETERINARY MEASURES IN FLOODED AREAS DESCRIBED Marin Stanescu p 22–29

N70-39851# Advisory Group for Aerospace Research and Development, Paris (France).
THE USE OF MICROFICHE FOR SCIENTIFIC AND TECHNICAL REPORTS
Aug. 1970 16 p refs
(AGARD-AR-27) Avail: NTIS

The use of the 105 × 148 mm microfiche for the report material of NATO nations is considered. The economies that are obtained once user acceptance is obtained are emphasized, and the reluctance of scientists to use this report material which requires a special reader is noted. Readers and reader printers are discussed, and advice is given on the examination and test of a new reader or reader printer. The large number of proposed standards for microfiche are outlined, and it is stated that the present 105 × 148 mm microfiche is adequate. It is recommended that European documentation centers should produce their own reports as microfiche and encourage their customers to make full use of this material. Author

N70-39940*# Scientific Translation Service, Santa Barbara, Calif.
ON THE BENEFIT OF SPACE RESEARCH SEEN FROM THE GERMAN POINT OF VIEW: A MACRO-MODEL FOR EVALUATING THE ORDER OF MAGNITUDE OF SPACE RESEARCH BENEFITS FOR THE FEDERAL REPUBLIC OF GERMANY [UEBER DEN NUTZEN DER WELTRAUMFORSCHUNG AUS DEUTSCHER SICHT: EIN MAKRO-MODELL FUER DIE ABSCHUTZUNG DER GROEBENORDNUNG DES AUS DER WELTRAUMFORSCHUNG ABLEITBAREN NUTZENS FUER DIE BRD]
H. H. Koelle Washington NASA Oct. 1970 78 p Transl. into ENGLISH from German report TUB-IR-4-68, 68 p
(Contract NASw-2035)
(NASA-TT-F-13239; TUB-IR-4-68) Avail: NTIS CSCL 05D

Preliminary estimates indicate an economic benefit of the order of 2.5 billion dollars for the year 1985. The scientific and political benefits will have to be added to this and can easily double this figure. More than 500 individuals contributed to the basic model by making information available in those areas in which benefits were observed or are expected in the future. Additional studies are required before a reasonable picture can be obtained concerning the cost-effectiveness of space activities. Author

N70-40254# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 13, NO. 8 [NUKLEONIKA, TOM 13, NR. 8]
1968 120 p refs Transl. into ENGLISH from Nukleonika (Poland), v. 13, no. 8, 1968 p 827–952 Sponsored by AEC and NSF
(AEC-tr-6931/8; TT-68-50011/8) Avail: NTIS

Papers presented include the following: localization of the axes of individual extensive air showers of cosmic radiation; use of semiconductor detectors for fission studies in high-energy proton beam; ion focusing properties of a double magnetic quadrupole lens pair; focusing of the time-of-flight diffractometer for structure analysis; resonance integral measurement by the pile oscillator method; heterogeneous isotopic exchange between the atom of a metal in the salt precipitate and its ion in the solution; the isotopic exchange kinetics in the gaseous hydrogen chloride-pyridine hydrochloride and the gaseous hydrogen chloride-picolinic acid hydrochloride systems; valence distribution of As-77 resulting from beta-decay in Ge-77 labeled inorganic crystals; adaptation of the time-to-amplitude converter to time measurements with the aid of semiconductor radiation detectors; the effect of a silver undercoat on the measurement of the gold coating thickness by the beta-reflection method; and a transistorized vacuum gage with a thermocouple probe. Author

N70-40315# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 13, NO. 10 [NUKLEONIKA, TOM 13, NR. 10]
1968 62 p refs Transl. into ENGLISH from Nukleonika (Poland), v. 13, no. 10, 1968 p 1035–1100 Sponsored by AEC and NSF
(AEC-tr-6931/10; TT-68-50011/10) Avail: NTIS

Investigations in chemistry, engineering and equipment, and physics are discussed. Examinations include carbon-14 isotope effects in dimethyl ether pyrolysis, heat transfer in nucular reactor liquid coolant, nonoverloading pulse amplifier, Valterra functional series applications to space independent homogeneous reactor kinetics, and spectral study on phosphorus-32 beta particle Bremsstrahlung. Also included is a microelement determination in bacterial mass using a reversed isotopic dilution method. E.H.W.

N70-40343# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 13, NO. 4–5. [NUKLEONIKA, TOM 13, NR. 4–5]
[1968] 224 p refs Transl. into ENGLISH from Nukleonika (Poland), v. 13, no. 4–5, 1968 361–590 Supported by AEC and NSF
(AEC-tr-6931/4-5; TT-68-50011/4-5) Avail: NTIS

Papers presented include: determination of main components in ores by radiometric methods, pulsed neutron source and bore hole fast neutron generator design, radiometric measurement of filter tube depth in bore holes, energy distribution of scattered gamma rays in natural gamma logging, elimination of chemical composition effects of rocks on gamma–gamma density logging, applications of isotopic methods for determining physical properties of soils in geotechnical cross section structure, and the use of tritium in hygrogeological studies. Also discussed are radiometric methods for studying water reservoir bottom tightness and an inorganic substance in hard and brown coals, single well isotopic methods for draining purposes in a mine, nuclear measurement for soil moisture and density, well logging for solid raw material

deposit detection, and analysis of copper and silver in copper ores by the photon activation method. A radiographic probe was used to determine the direction of ground water filtration in drill holes and the direction and flow rate in open water reservoirs were measured. Tracer studies on mixing of waste waters with surface waters are described. E.H.W.

N70-40344# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).

NUKLEONIKA, VOLUME 13, NO. 9 [NUKLEONIKA, TOM 13, NR. 9]

1968 80 p refs Transl. into ENGLISH from Nukleonika (Poland), v. 13, no. 9, 1968 p 953-1034 Sponsored by AEC and NSF

(AEC-tr-6931/9; TT-68-50011/9) Avail: NTIS

Letters and papers in biology, chemistry, engineering and equipment, and physics are presented. Information includes: radioactive contamination of milk caused by nucular weapon experiments, adsorption activity of phosphorus-32 on penicillin vials, scintillation monitor for field measurements, cosmic ray detection using neon hodoscope, Mossbauer's effect in Fe(C6H11O17)2 · 2H2O, and Coulomb backscattering of heavy charged particles. A pulsed shape discriminator and radioactive tracer methods for air mixing in a ventilated room are also discussed. E.H.W.

N70-40383# Federal Council for Science and Technology, Washington, D.C.

CATALOG OF FEDERAL LABORATORY-UNIVERSITY PROGRAMS AND RELATIONSHIPS

Aug. 1969 81 p

Avail: SOD $0.75

Training programs and cooperative relationships between federal laboratories and contract centers and universities are described. The following areas are included: education of laboratory and other employees, community oriented programs, cooperative work-study programs, work-oriented activities with universities and industries, short-term and long-term exchange of college faculty members in federal institutions and federal employees in other organizations, equipment interchange, curriculum development, and use of television and other audio visual aids. N.E.N.

N70-40399*# New Mexico Univ., Albuquerque. Technology Application Center.

PROGRAM DEVELOPMENT AND TAC OPERATIONS AND ACTIVITIES Annual Report FY 1970

William A. Shinnick 1970 36 p

(Contract NSR 32-004-049)

(NASA-CR-113595) Avail: NTIS CSCL 05A

Photographic and information dissemination activities are summarized, as well as other technology applications services, particularly dissemination of data on remote sensing and data acquisition and interpretation techniques. Product searches on ceramic and metal powder characterization, metal carbides technology, and memory systems technology are outlined. E.H.W.

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC

NASA deposits its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers located in the organizations listed below. Each center is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

CALIFORNIA
University of California, Berkeley

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University of Colorado, Boulder

DISTRICT OF COLUMBIA
Library of Congress

GEORGIA
Georgia Institute of Technology, Atlanta

ILLINOIS
The John Crerar Library, Chicago

MASSACHUSETTS
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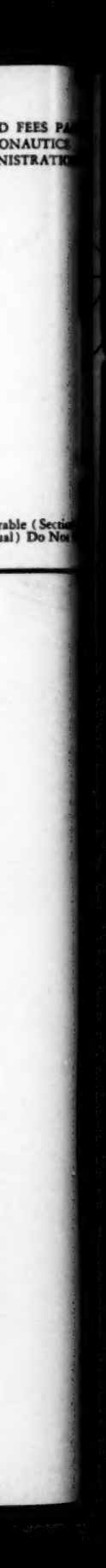
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